ABSTRACTS

INTERNATIONAL CONFERENCE

Biodiversity Research of Mongolia
20-23 September, 2017

Editors:
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International Conference on "**Biodiversity Research of Mongolia**"

20-23 September 2017, Ulaanbaatar, Mongolia

Dedicated to the 75th Anniversary of National University of Mongolia and the 50th Anniversary of the research and cooperation between National University of Mongolia and Martin-Luther University Halle-Wittenberg, Germany (1967-2017)

Hosted by
Department of Biology, School of Arts and Sciences,
National University of Mongolia

in cooperation with
Martin-Luther-University Halle-Wittenberg, Germany
Senckenberg Museum of Natural History Görlitz, Germany

Programme overview

September 20, 2017		
Time	**Programme**	**Venue**
17.00-19.00	Welcome evening	Coffee shop, 1st floor, Library building, NUM
September 21, 2017		
08.30-09.30	Official registration	Academic hall, Building I, NUM
09.30-10.30	Opening ceremony	
10.30-11.00	Group photo	
11.00-11.30	Coffee break	
11.30-13.10	Oral presentations	
13.10-14.30	Lunch break	BD's Mongolian barbeque restaurant
14.30-15.50	Oral presentations	Academic hall, Building I, NUM
15.50-16.20	Coffee break	
16.20-17.40	Oral presentations	
17.40-18.30	Poster presentations	
18.30-22.00	Dinner	BD's Mongolian barbeque restaurant
September 22, 2017		
Session 1: Zoology		
09.00-10.30	Oral presentations	Academic hall, Building I, NUM
10.30-11.00	Coffee break	
11.00-12.30	Oral presentations	
12.30-13.30	Lunch break	BD's Mongolian barbeque restaurant
13.30-15.00	Oral presentations	Academic hall, Building I, NUM
15.00-15.30	Coffee break	
15.30-17.00	Oral presentations	
17.00-17.20	Closing remarks of the conference	
17.20-18.30	Honorary Doctor Award Ceremony	
19.00-22.00	Closing dinner	Conference hall, 5th floor of Library buildng, NUM
Session 2: Plant		
09.00-10.30	Oral presentations	Room number 320, Building I, NUM
10.30-11.00	Coffee break	
11.00-12.30	Oral presentations	
12.15-13.30	Lunch break	BD's Mongolian barbeque restaurant
13.30-15.00	Oral presentations	Room number 320, Building I, NUM
15.00-15.30	Coffee break	
15.30-17.00	Oral presentations	
17.00-17.20	Closing remarks of the conference	Academic hall, Building I, NUM
17.20-18.30	Honorary Doctor Award Ceremony	
19.00-22.00	Closing dinner	Conference hall, 5th floor of Library building, NUM
September 23, 2017		
09.00-19.00	Field trip to Hustai National Park	
September 24, 2017		
Departure of delegates		

FOREWORD

The unique biodiversity, i.e. birds and mammals, reptiles, insects and flowers all contribute to the beauty of Mongolia, making it a rich and varied country, appreciated far beyond its borders. By ratifying the Convention on Biological Diversity, Mongolia has also taken on the responsibility of safeguarding its biological diversity and protecting the species that belong to and thrive in the Mongolian landscape. It is thereby not only the responsibility of Mongolia and its citizens to protect what is here, but also global responsibility of the international community of which Mongolia is a part.

However, the speed of the species disappearance is now higher than nature has ever experienced before and the risk of extinction of species and failure of ecosystems is paramount. It is the responsibility of all global citizens to protect the heritage, the species, the ecosystems, and secure those ecological processes that continue to contribute to our common wellbeing. This is our heritage and this is our responsibility.

The most important value of biodiversity is to provide human beings with ecological or ecosystem service. This service is based on the species present in and building the functions of the ecosystem. These functions can hardly be substituted by human interventions or other activities. Ecological services are perennial, they are timeless and certainly a necessity for the survival of mankind. The heritage of Mongolia is rich and contains a wide variety of cultural and biological heritages that create the country that we know today.

This conference is dedicated to the 50th anniversary of the partnership between the National University of Mongolia and the Martin Luther University Halle-Wittenberg, which is a historical event for scientists of both the countries. To foster cooperation between biologists of two countries, the National University of Mongolia and the Martin Luther University Halle-Wittenberg created “Treaty of Cooperation” in 1967. In the frame of this partnership, the Mongolian-German expeditions were jointly conducted, which supported the development of scientific study and research capacity in Mongolia.

The collaborations between two universities diversified over the years and were extended to cover an increasing number of research disciplines as well as several other institutions, such as Senckenberg Museum of Natural History in Goerlitz, Georg August University of Goettingen, Philipps University of Marburg and University of Osnabruck etc. Thus, during the 50 years of cooperation, bilateral relationships between the National University of Mongolia and the Martin Luther University Halle-Wittenberg have reached remarkable breath and also depth.

Throughout the entire period of the German-Mongolian joint expeditions, both the researchers and students of the participating countries were able to learn from each other in terms of research design, new methods and technical skills, which made them cooperative and productive fueling with energy for accomplishment of the task with greater outcomes. Without the kind cooperation, friendly relationship, faithful dedication and great energy of our fellow scientists, senior colleagues, current researchers and students, obviously the collaboration would not have succeeded. I would like to wish all the best all participants of this conference and the prosperity in our future collaboration.

Prof. DSc. Badamdorj Bayartogtokh

Contribution of German scientists to the study of terrestrial fauna of Mongolia

R. Samiya (Samjaa)[1], K. Ulikpan[1], B. Bayartogtokh[1], N. Batsaikhan[1], S. Gombobaatar[1], S. Shar[1], D. Lkagvasuren[1], Kh. Munkhbayar[3], Kh. Terbish[1], N. Tseveenmyadag[2],[4], B. Nyambayar[4]

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German scientists have been playing significant role in faunal study in Mongolia for last century. Two German scientists, P. S. Pallas and G. Radde conducted a great faunal research particularly vertebrates on the border of Siberia and Mongolia. More than thirty species of mammal were described by P. S. Pallas in Mongolia as new species for science. G. Radde wrote the first detail morphological description of Mongolian marmot, Large-eared vole, Brandt's vole, and Mongolian vole in biological science.

Since national academic organizations established such as National University of Mongolia in 1942 and Mongolian Academy of Science in 1962, faunal research in Mongolia began to develop for new level.

Joint Mongolian and German biological expeditions gathered extensive field data on biodiversity in Mongolia covering most areas of the country in 1962 and 1964.

Since a memorandum of understanding signed between National University of Mongolia (NUM) and Martin-Luther University Halle-Wittenberg, Germany in 1967, biologists from both universities have been conducting extensive field works across the country.

We can conclude that contribution of German biologists to faunal study of Mongolia were the followings:

1. 18th and 19th century. German scientists conducted faunal research in Russian and Mongolian border area.
2. 1962 and 1964. Joint biological expeditions run across Mongolia with MAS.
3. 1967. Joint field biological surveys were conducted by NUM and Halle-Wittenberg University.
4. 1970-1980. German biologists' surveys, especially on birds and insects through tourist organization.
5. Scope of collaboration has been expanded through the collaboration with Universities of Goettingen, Marburg and Senckenberg Museum of Natural History since 1990.
6. Collaborative field surveys on insects, birds, and bats have been conducted by individual scientists on faunal study in Mongolia

German scientists have been greatly contributed to the development of joint biological expeditions on certain group of animals and plants in Mongolia. We can summarize their contributions to the biodiversity research and conservation as follows:

Mammal scientists have been closely collaborating on different aspects of mammal species. One of the pioneering results on this groups was research results of mammals from two initial joint expeditions, written by M. Stubbe and N. Khotolkhuu (1968). During the introduction programme of Eurasian beaver entire Internal Central Asian River Basin Drainage joint expeditions conducted comprehensive field surveys on fauna and flora at the area. As result of the joint expeditions, Forest dormouse, Hog badger, Tamarisk jird, Ural field mouse, noctule, and few shrew species were documented as the first time for Mongolian fauna. Detail ecological experimental investigations on Eurasian beaver, Forest dormouse, Brandt's vole, Mongolian silver vole, Asiatic wild ass and other small nocturnal mammals including *Alactaga* species were extensively organized by the joint team and summarized in various references such as Stubbe et al. 1971; 1983a,b; 1986a,b,c,d,e; 1989a,b; 1990; 1991; 1992; 1994a,b,c,d; 1998; 2005a,b,c,d; 2007a,b; Zoefel 2005.

German ornithologists published about 200 scientific papers and recorded 40 species as new for Mongolian avifauna. Series of scientific publications on biology and distribution of 354 species of birds in Mongolia were published by Piechocki (1968) and Piechocki and Bold (1972) After this series of publications, scientists from both universities were completed few major references by R. Piechocki, M. Stubbe, K. Uhlenhaut and D. Sumiya (1981, 1982). W-D. Busching's collection on feathers of birds in Mongolia was significantly contributed to solve the issue of taxonomy and phylogeny of birds in the country during the 1990s. Recent major references on breeding ecology and migration of raptors were published by M. Stubbe and his colleagues (Stubbe *et al.* 2010).

Amphibian and reptile surveys were initiated by famous explorers in the 19th century. Mongolian toad *Bufo radei* STRAUCH, 1876 was described by G. Radde. German scientist, F. Obs and the first national herpetologist Kh. Munkhbayar completed the first publication on amphibians, and followed by G. Peters from the joint expedition of Mongolian and German academies, and Grosse and Meyer from Halle-Wittenberg University (Peters, 1971a; 1971b; 1982; 1984; Peters, Semenov and Borkin, 1990; Meyer, Zinke, 1992; Grosse, 1987; Grosse, Stubbe, 1986; Grosse, Stubbe, 1989).

Mongolian-German expeditions' field works focused on most of major invertebrate groups, including Protista through worms and arthropods. Lesniak et al. (?) discovered the species, Amplicomplex, which is a blood parasitic protozoan of Haemosporina. Among the 615 species of spiders found in Mongolia, 30 species were documented by Mongolian-German expeditions. A large number of ectoparasites were collected by M. Stubbe and A. Stubbe. They recorded 27 species of parasitic flies, fleas and ticks from 15 species of bats. Based on the collection materials by the Mongolian-German expeditions, 64 species of true bugs or hemipterans, 54 species of mayflies,

13 species of dragonflies and damselflies, 52 species of mallophags, more than 190 species of beetles, 8 species of hymenopterans, 50 species of siphonapterans and 46 species of dipterans were recorded as the first time for Mongolia.

Botanical research in the scope of the Mongolian - German expeditions

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Mongolia- German botanical research continuously progressed for the more than 50 years since the first joint expedition organized in the 1962. Only botanist of the University Halle organized nearly 60 short and long expeditions and field works and published 70 research papers in cooperation with their Mongolian colleagues between 1962-2006. Since 2000 both country's joint botanical research expanded greatly specially by valuable initiatives of partners from University of Geottingen, Senkenberg Museum, University of Osnabruck and University of Kassel. Current research mainly focuses on the plant-environment interactions especially global change; biotic and abiotic stress and provides new information on fundamental processes or mechanisms of the vegetation dynamics of the steppe and forest ecosystems of Mongolia. Key results made a great contribution to advance our understanding of plants and vegetation characteristics of the region and underpinning the improvement of plant resource conservation and sustainable uses of the country. Same time this cooperation contributed markedly to train a hole new generation in the discipline for Mongolia.

Joint plant-ecological research by the University of Goettingen and Mongolian institutions

M. Hauck, Ch. Dulamsuren

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The Department of Plant Ecology and Ecosystems Research of the University of Goettingen started much later with German-Mongolian research activities than the University of Halle-Wittenberg, but has established long-standing research

cooperations. The research focus in Mongolia is on the biodiversity and ecosystem functions of Mongolia's boreal forest in the forest-steppe and the mountain taiga. Geographically we so far had a focus on the Khentei Mountains, the Khangai Mountains, and the Mongolian Altai.
First projects were granted by the German Science Foundation (Deutsche Forschungsgemeinschaft, DFG) in 2005 and 2007 to Ch. Dulamsuren. These projects dealt with the ecology and the ecophysiology of the forest-steppe ecotone and with the climate-warming response of tree-ring width and forest regeneration. During this project, we could demonstrate for the first time the increasing limitation of Mongolia's boreal forest due to summer drought as the result of global climate warming, a finding that was made at many other places of Mongolia's forest-steppe ecotone afterwards and suggests a grim future for Mongolia's boreal forest with increasing temperature.
From 2010 to 2017, a project of the Volkswagen Foundation was granted to us (Altai Project), which gave us the opportunity for joint research with scientists from Mongolia and Kazakhstan. The project included studies on plant and animal diversity, ecosystem functions as well as the socioeconomics and socioecology of pastoral livestock husbandry. Since 2017, the mechanisms behind the drought limitation of Mongolia's boreal forest are studied in a project granted to Ch. Dulamsuren from the DFG. In this project, wood-anatomical and ecophysiological analyses are combined with tree-ring analysis in larch and birch forests of the Khentei Mountains.

Future collaboration options in biodiversity research and education between the Universities in Ulaanbaatar and Halle (Saale)

Frank Steinheimer
Natural Sciences Collections, Martin Luther University Halle-Wittenberg, Germany

More than 50 years of close collaboration between the National University of Mongolia and Martin-Luther University of Halle (Saale) have produced a huge amount of scientific knowledge, have fostered the mutual transfer of scientific knowhow and have assembled large natural history collections. This talk aims introducing to research options based on the collected material as well as discussing new options for further collection based research and teaching. The Natural Sciences Collections (ZNS) of the University of Halle (Saale) hold one of the best Mongolian vertebrate and insect collections world-wide as well as a substantial collection of domestic animals and their wild ancestors. The ZNS is specialized in Eocene fossils and the reconstruction of palaeo-environments. The staff of the ZNS provides a wide range of curatorial and collection management knowhow, preparation skills and

education/teaching practice. We are interest in research cooperation which would fit into the given profile:
1) Research on the impact of domestic animals on soil arthropods and analyses of different domestic animal species according to their influence on biodiversity changes.
2) Domestication processes in camels, horses and sheep including an assessment on how much natural selection has been limited in each domestic breed.
3) Reconstruction of palaeo-environments especially between the Eocene and the Pleistocene using fossils.
4) Science-education projects and their evaluation in a different cultural context.

Education on Mongolian Biodiversity Cooperation between Senckenberg and NUM

Willi E. R. Xylander
Senckenberg Museum of Natural History, Görlitz, Germany

For more than 10 years the binational exchange of education on and transfer in biodiversity research - comprising a variety of formats, activities, target groups and localities - constitutes a success story between NUM and Senckenberg.

Academic teaching: Several professors of Senckenberg as well as NUM gave lectures on Mongolian biodiversity at universities in Mongolia (especially at NUM) and Germany (e.g. Halle, Leipzig, Görlitz and Zittau).
Summer schools: For about 10 years now reseachers from Senckenberg and NUM together realized summer schools and international field courses in various areas of Mongolia funded e. g. by Senckenberg, GIZ and DAAD. About 60 Mongolian students participated in these courses.
PhD-programs: Doctoral students from NUM took part in German PhD-programms, e. g. the "DAAD sandwich dissertation program" where supervisors from NUM and Germany (Senckenberg) are responsible for the doctoral theses of Mongolian candidates. The doctoral students spent several months or years at the Senckenberg Museum in Görlitz – taking the opportunity of academic teaching, holding lectures and taking part in the science and society program of Senckenberg Görlitz.
Biodiversity and Collection Management – a new master course: Since 2014 the Senckenberg Museum of Natural History in Görlitz together with the IHI Zittau and the Technical University in Dresden organizes a consecutive master course on biodiversity and collection management. For foreign students every year two scholarships of the Dietmar-Schmid-Education-Fond are reached out which was used to support a Mongolian student who participated in the master program and

will finish her thesis in autumn 2017. The course includes internships at several Senckenberg institutes and provides broad taxonomic and practical expertise, basic knowledge on museum´s economy and management as well as general aspects of museum governance.

Exhibitions: The Senckenberg Museum in Görlitz produced a touring exhibition on the biodiversity research in Mongolia in cooperation with NUM and presented it e. g. at the museum in Görlitz, the Senckenberg Naturmuseum in Frankfurt and the German embassy and other locations in Ulaanbaatar. The exhibitions showed aspects of biodiversity of Mongolia in various landscape types as well as insights into the traditional culture and the field research situation. It also reflects the close cooperation between Senckenberg and NUM.

Restoration course for the historical bird collection: 2016 two experts from the Senckenberg preparation/restoration department gave a course on most recent techniques of bird preparation and restoration in which specialists from Bogd Khaan Museum, National Museum of Natural History of Mongolia, NUM and Senckenberg cooperated and exchanged.

The cooperation between Senckenberg and NUM has a long tradition and enables exchange of expertise in the broadest sense with benefit for both partners.

Adaptation of key forest ecosystems to climate change

Klaus Schmidt-Corsitto
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

"Adaptation" of forest ecosystems is one of the biggest challenges to face climate change effects. Mongolian forest, as an important resource, covers 9.1 Mha and it is threatened by the effects of climate change. Climate change effects, enhanced temperature and reduced precipitation, cause an increase in fire frequencies and pest infestations in the forest. In the light taiga ecosystem, fire and pest infestation are natural circumstances for natural regeneration (disaster regeneration) with a frequency of 80 to 120 years. As a result, a higher fire frequency, earlier regeneration, and shorter life cycle of the light taiga forest are expected. Natural disaster caused by fire and pest should be at the least accepted in protected areas. In economic forests the adaptation is a way that forest stands persistent during drought, fire, and pest in a better way is the "adaptation" challenges foresters facing by silvicultural measurements. To reduce disaster risks in the economics forests, the most important adaptation of silvicultural measurements are: 1) use trees at the age of culmination of total growth, 2) prioritize mixed forests (broadleaved trees, conifer trees) to improve organic layer, 3) regulate the tree-to-tree distance to optimize growing condition for trees, 4) promote multi-level forests for the better stand stability, and 5) promote the

enrichment of plantation to compose mixed forest types. Even though climate change is an unavoidable process, the silvicultural measurements that reduce disaster risks could hinder the forest shift due to the regional climate change effects.

Joint German-Mongolian biodiversity research and the responsibility of scientists for the protection of natural heritage

Hans D. Knapp
Succow Foundation

1. Biodiversity Research Cooperation

The cooperation between the Martin-Luther-University Halle-Wittenberg and the Mongolian State University Ulaanbaatar for about a half century is one of the most important "institutions" of joint biodiversity research in long time continuity. It bases on joint scientific interest on the rich and special flora, fauna, landscapes and ecosystems of Mongolia, but also on friendship of the scientists. This cooperation survived the changes of the political systems in both countries, and it is ongoing in new dimension. Several universities and research institutions from Germany are following this cooperation approach with bilateral projects, like joint expeditions, staff exchange, students building, and international conferences. The outcome is a great potential of well-educated experts, a large number of publications and an important contribution to the scientific knowledge about the nature of Mongolia.

2. Scientific based Protection of Natural Heritage

Already in the past, few projects focused on conservation goals, e.g. the transmission of beaver to a river wetland in the Gobi. The implementation of a system of National Parks and large protected areas in Mongolia as well as the nomination of World Natural Heritage Sites would not be feasible without the high level of biological and ecological research. The successful re-introduction of the wild horse is one of the most spectacular conservation projects worldwide. The Red Book of Mongolia, the governmental programs for biodiversity conservation, and the activities of NGO like WWF as well, participate and base on the large pool of scientific knowledge and experience.

3. Future challenges and tasks

As a country in the heart of Asia under extreme and very diverse climatic conditions. Mongolia underlies a strong impact by processes of global change in the current period of the Anthropocen. The most serious problems are climate change (e.g. increasing dryness), desertification and degradation of plant cover as the result of unregulated growth of livestock and overgrazing, as well as the destruction of

forests and woodland.
Scientific research has to analyze the reasons, the structure and the processes of the complex problems, and to search for solutions. It is also the responsibility of scientists to formulate recommendations for political decisions and practical implementation with the general goal, to stabilize ecosystem functions, to regenerate/to restore degraded ecosystems, to protect biodiversity and the natural heritage as a base for human life and benefit.
The special responsibility of universities is to educate in the knowledge and fascination of the diversity of plant and animal life and their ecological functions. Universities also have to motivate young people for taking these challenges of changing world and for managing the future in real sustainability and respect to the natural heritage.

Factors of deforestation in the forest-steppe landscapes of Mongolia

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Degradation of landscapes associated with their deforestation, is currently one of the most widespread ecological problems in the world. Therefore, it is treated as particularly important from a functional point of view to preserve the ecological stability of forest regions. Deforestation occurs in the forest-steppe zone of Eurasia, including the southern (Mongolian) part of the Baikal Lake basin. Over the last hundred years around 40% of Trans-Baikal forests were more or less damaged. The processes of deforestation is primarily associated with changes in the landscape-ecological conditions of forest ecotopes, reducing the share of indigenous boreal forest or drastically reduce its importance in the formation of after-forest communities. Field studies conducted in 2014-2016 in the forest-steppe landscapes of the lake Baikal basin, has allowed spatially isolate and study the three main factors of deforestation.
Desiccation of the soil layer with roots and is fatal implications to forest communities are apparent in the key area “Shamar” where pine forests are replaceв with *Armeniaca sibirica*. This shrub marks ecotopes not suitable for afforestation without special agro techniques. A similar phenomenon is to be expected in a much wider area because of adverse climate trends, which are recorded at meteorological stations in different parts of the Baikal Lake basin.
Deforestation could occur for the opposite reason – waterlogging the soil layer with roots that was observed in the key area “Nalaikh” where on the place of larch forest

we can see dense thickets of *Betula fusca*. This process is relevant primarily for mountainous depressions, and can be considered natural, but can be also a result of mining or development of power stations. Both increased significantly in Mongolia in the last 20-25 years.
Widespread and serious problem in the Baikal Lake basin is competitive relations between woody and shrubby vegetation. As a consequence, forests transform into bushes over large territories. In different key areas, depending on natural conditions, the process is dominated by various species of shrubs: the area of "Sharyn-Gol" - *Dasiphora fruticosa*, "Salkhit" - *Caragana microphylla*, "Tosontsengel" - *Caragana bungei*. Shrubs not only replace the decaying forests, but also serve as indicators of, potentially suitable for artificial reforestation, as in the case of *Dasiphora fruticosa*. The processes of deforestation and bush successions have regional variants strongly dependent on environmental characteristics and ecological demands of bushes species.
As a general result, the map of distribution of dominant bushes species in forest-steppe landscapes of the Mongolian part of the Baikal Lake basin was composed.

Global-warming effects on forest performance in the southernmost boreal forest of Inner Asia

Ch. Dulamsuren, B. Bat-Enerel, Yo. Yeruult, Kh. Ganbaatar, D. Sain-Dondov, M. Khishigjargal, J. Tsogtbaatar, M. Klinge, M. Hauck, Ch. Leuschner
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Central and semiarid North-Eastern Asia was subject to 20th-century warming far above the global average. Since forests of this region occur at their drought limit, they are particularly vulnerable to climate change. We studied the regional variation of temperature and precipitation trends and its effects on tree growth and forest regeneration in Mongolia, eastern Kazakhstan and at the north-eastern edge of the Tibetan Plateau.
Tree-ring series from coniferous trees, mainly of Siberian larch (*Larix sibirica*), collected in different regions of Mongolia and eastern Kazakhstan were analyzed and related to available climate data. Climate trends underlie a remarkable regional variation leading to contrasting responses of tree growth in taiga forests even within the same mountain system. Within a distance of a few hundred kilometers (140 to 490 km), areas with recently reduced growth and regeneration of larch alternated with regions where these parameters remained constant or even increased. Reduced productivity could be correlated with increasing summer temperatures and decreasing precipitation, improved growth conditions were found at increasing precipitation,

but constant summer temperatures. In areas with decreased annual stem increment, regeneration of Siberian larch also decreased, whereas in regions, where trees exhibited increased annual stem increment, regeneration increased. In the north-eastern Tibetan Plateau, we studied the stemwood production, regeneration and mortality of *Picea crassifolia*.

While tree-ring analysis allows inferences on the climatic factors influencing the trees' productivity and provides information on trends in climate and forest productivity over extended periods, ecophysiological measurements and radiocarbon ($\delta^{13}C$) signatures of leaves and needles provide evidence on the current vitality status and stress conditions of the trees. Moreover, ecophysiological measurements can be used to detect mechanisms of drought stress in trees that lead to reductions in stem increment. Measurements of shoot water potentials during the growing season exhibited daily minimum water potentials close to the point of zero turgor for extended periods. The drought stress indicated by these results is in line with the current low annual increment. Investigations of the xylem wood anatomy and hydraulic conductivity showed that *Larix sibirica* adapts its hydraulic architecture to interannual and site-specific variations in water availability.

The rhizosphere is also an important part of forest ecosystems, which is involved in water and nutrient uptake and carbon sequestration. Therefore, we studied the fine root system of larch forests in the Khangai Mountains, the Mongolian Altai, and the north-eastern Tibetan Plateau. The key result of our study was that the larch forests in the potentially drought-stressed forest-steppe ecotone of Mongolia do not respond to these specific site conditions with the increased formation of fine roots, but invest only little carbon in their fine root system. Combined with the generally small annual stem increment of larch found in tree-ring analyses from the forest-steppe ecotone in Mongolia, this suggests that trees under the challenging environmental conditions at the drought limit of forest growth are overall little productive and thus little flexible to respond to worsening site conditions, including the increase of aridity by global warming.

Since declines of productivity and regeneration are apparently more widespread in Central Asia than the opposite trend, a net loss of forests is likely to come, as strong increases in temperature and regionally differing changes in precipitation are predicted for the 21st century. In addition our tree-ring analyses give evidence of strongly increased selective logging after the transition from the planned to market economy in Kazakhstan and Mongolia. Partially heavy logging was restricted to the years immediately following the political changes and partly logging has continued.

Occurence of Soricidae (Mammalia: Insectivora) in Mongolia

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New data on the Mongolian fauna of Soricidae came in the last decades from Russian scientists as Ju.G. Švecov, N.I. Litvinov and B.I. Sheftel, last not least in cooperation with Mongolian mammalogists. We remind on the publications of N. Chotolchu, D. Bazardorž and R. Samjaa with his team. Also in the future, there is a lot to do for understanding of biology, ecology and distribution of the Mongolian shrews. We have summarized the most important publications on shrews and made a grid mapping together with the results of the Mongolian-German Biological Expeditions. Up to date, there are known the following species from the Mongolian territory: *Neomys fodiens, Crocidura suaveolens* (or *C. sibirica*), *Crocidura shantungensis* as well as the *Sorex*-species, *S. roboratus, S. daphaenodon, S. isodon, S. minutissimus, S. araneus, S. caecutiens* and *S. tundrensis*.

Putting Mongolian rangelands into perspective: status and trends in the Eurasian steppe biome

K. Wesche
Department of Botany, Senckenberg Museum of Natural History Görlitz, Germany

The vast steppes of Mongolia's central and eastern parts represent some of the most extensive rangeland regions. Rapid human and economic development exposes Mongolian rangelands to novel pressures, and variations in climatic conditions add extra stress. The last two decades thus witnessed increasing concern about rangeland degradation and desertification, often accompanied by intense debates on spatial extent and magnitude of these effects.
The talk puts the Mongolian case in perspective against states and changes in the wider Eurasian steppe biome. Steppes and related grasslands extent from western Europe to eastern Asia, covering some 9-10 Mio. km² and thus forming the world's second largest continuous terrestrial biome. Because of the sheer size of these steppes, changes are of global relevance, and not surprisingly a rich though somewhat scattered literature addresses issues of human and livestock impact, as well as climate change effects on steppes and related rangelands. The Eurasian perspective demonstrates that conversion to arable fields represents a key threat for

steppe ecosystems in most of the region. Severe overgrazing has been demonstrated for the Mediterranean and for the Chinese province Inner Mongolia. Global change effects are, in contrast, not as apparent, largely owing to the generally variable conditions in steppes making detection of trends difficult. Summer heat became more pronounced in Mediterranean rangelands with possible detrimental effects on perennials, and changes in precipitation patterns have altered productivity of many Tibetan rangelands.

Mongolian steppes thus are special: Compared to the wider steppe biome, levels of conversion are very low, and though being locally severe overgrazing effects still seem limited. Global warming affects highly continental regions more than oceanic sites, and pronounced temperature changes in Mongolia are not surprising. Indeed, detrimental effects on tree growth in the forest steppe zone are apparent, while effects on grasslands are much less obvious. Clearly, Mongolia hosts one of the world's most important and intact rangelands, and the country has an outstanding responsibility for conservation of the Eurasian steppes.

Pastoral nomadism in the Mongolian forest-steppe under a changing economy and a warming climate

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Pastoral nomadism is globally on the retreat and displaced by sedentary land use systems. We analyzed the socioeconomics and socioecological feedbacks of mobile livestock-keeping in the forest-steppe of western Mongolia, in a country where still 30 % of the total population lives from pastoral nomadism. We aimed at connecting the results of herder interviews from two study regions (Mongolian Altai, Khangai) to the concepts of social-ecological systems (SES) science and to analyze adaptations to the recent post-socialist transformation from planned to market economy and to global climate warming. The interviewed pastoralists strongly relied on the use of local ecosystem services and the studied SES were thus following 'green loop' dynamics. However, the two study areas differed in the herders' responses to recent changes in the socioeconomic frame conditions and in climate. In the Khangai, herders ensured a high spatiotemporal exploitation of the available pastureland with seasonal movements. In the Altai, most pastoralists have reduced or even stopped seasonal movements. This makes the pastoral SES in the Altai less resilient towards climate warming, which has great impact on the herders' decisions in the Altai, but not in the Khangai, and potentially leads pastoralism in the Altai into a 'trap'

situation. A key factor fostering the herders' mobility and market opportunities was the ownership of trucks. Ethnicity (Kazakh minority vs. Mongolian majority) was not of great significance to the daily livestock business, but for individuals looking for alternatives outside their green loop economy due to language and cultural barriers.

The international legal regime on biological diversity and its relevance for Mongolia

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Based on an explanation of the concept of biodiversity under international law, the talk will provide a brief tour d´horizon regarding pertinent international environmental law dealing with aspects such as conservation of endangered species, desertification and deforestation. Relevant instruments and documents will include the Convention on Biological Diversity and its Protocols on Access and Benefit Sharing and on Biosafety, the Convention on International Trade with Endangered Species, the Convention to Combat Desertification and the Forest Principles. In addition, the potential effects of climate change will provide a major aspect of the talk. The discussion will focus on issues such as the nature, scope and effectiveness of the relevant instruments, trying to assess the extent to which the law as it stands is able to deal with current threats to biodiversity in Mongolia. This is intended to spark off an interdisciplinary debate on how the international (and the national) legal framework might be improved in the future and how international monitoring bodies might interact with the Mongolian authorities in order to aid that process.

Preliminary results of breeding ecology studies of Amur falcon (*Falco amurensis*) in Hustai National Park, Mongolia

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The Amur falcon (*Falco amurensis*) is a small falcon species that breeds across Mongolia, northern China, and western Russia and winters in southern Africa. The pioneering work in its breeding range was O. Shagdarsuren's breeding ecology

research in the Gobi desert of Mongolia in 1983. From 1999-2002 a Mongolian-German joint ornithological team also studied the breeding ecology of this species in the Shaamar area, Northern Mongolia, resulting in a "diplom biology" thesis at Halle-Wittenberg University, Germany (Schäfer, 2003 & 2004) Finally, a female Amur falcon was tracked its migration from Hustai National Park in 2009 (Dixon et al. 2011) using a satellite transmitter. Building on this past work, our objective was to investigate nest site selection, clutch size, and number of chicks fledged to understand the relationship between nest success and nest and site factors. Our study site, Hustai National Park in central Mongolia, was chosen because of a known breeding population in several valleys within the Park. We studied nesting Amur falcons in Hustai during the summers of 2011, 2013 and 2014. The Amur falcon does not build its own nest, but prefers to select old nests of Common magpie *(Pica pica)*, Daurian jackdaw *(Coloeus dauuricus),* Carrion crow *(Corvus corone),* and rarely Black kite *(Milvus migrans)* or Upland buzzard *(Buteo hemilasius)*. All of these nests are built on trees in forest steppe, mountain steppe and Gobi desert in Mongolia. All documented breeding pairs of Amur falcons (n=27) in our study area selected nests built by Common magpie. The nests were constructed on well-sheltered parts of trees and were tightly closed in shape. Of active nests in our study areas, 89% were placed in birch (*Betula* sp.) and 11% in elm (*Ulmus* sp.) trees. Average clutch size was 3.9 ± 0.73 (max 5, min 3, n=106) and average number of nestlings in nests that hatched was 3.2 (max 4, min 1). For our three study years combined hatching success was 88.1%. Fledging success varied by year (90% in 2011, 73% in 2013 and 62.2% in 2014). Number of eggs was not correlated to nest height above the ground (r^2=0.2, p=0.52, df=18), elevation (r^2= - 0.3, p=0.295, df=18), air temperature (r^2=0.4, p=0.16, df=16), and nest parameters (diameter, height and depth) (r^2=0.2, p=0.178, df=16). Number of chicks hatched was not correlated to distance between conspecific nests (r^2=0.1, p=0.75, df=17), air temperature (r^2=-0.5, p=0.039, df=16), elevation (r^2=-0.1, p=0.35, df=18), tree height (r^2=-0.2, p=0.59, df=18), nest parameters (r^2=-0.1, p=0.693, df=16). These nest and site factors do not appear to have influenced the number of eggs and chicks of Amur falcons in our study area. Breeding success of the species may be influenced by other factors beyond the scope of this study, including variation in the strategies and experience of individuals and pairs. Inter-annual differences in hatching and fledging success may be affected by environmental and ecological factors such as rainfall, prey population dynamics, and predator densities and behavior..

Migration of Black-eared Kites from central Mongolia

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Until now the wintering range of the Mongolian Black-eared Kites (*Milvus migrans lineatus*) was entirely unknown. These raptors were studied in 2016 via a cooperation between the Mongolian Wildlife Science and Conservation Center (WSCC), the Institute of General and Experimental Biology of the Mongolian Academy of Science (MAS), the Institute of Environmental Ecology of Korea (IEEK) and the German Max-Planck-Institut (MPI) of bablabla.

A total of 25 Kites had been caught in beginning of September 2016 of which 15 got satellite transmitters (10 provided by the MPI, 5 provided by the IEEK). All birds were caught in northern central Mongolia (either near the villages of Dashinchiling and Bayan Nuur in the Bulgan Aimag or at the Songino village directly west of Ulaanbaatar) by members of the WSCC and MAS. The 70 g, solar-powered transmitters need to connect to the phone network to transfer the data to the main computer where they can be processed.

So far the transmitters recorded the movements of the individual kites for one year (see map). Birds from the Songino site left the area directly to migrate southwest through southern Mongolia into China from where they turned west. During migration they crossed not only the Gobi Desert but also the Tibetan Plateau which has an altitude between 4500 to 4800 m a.s.l. One bird migrated 2452,5 km in without a break to the border between Myanmar and China. After 5 days it was in southern Myanmar. The fasted birds travelled between 103 – 112 km within 2 hours. During the first 10 days of their migration the daily maximum mileage covered varied between 118 and 430 km (averaging in 245 km/d).

The wintering area of our birds lies in NE India, Nepal, Bhutan, Bangladesh, Myanmar and Thailand. Spring migration started by the end of March and brought them back to Mongolia via China. 2 birds even over-summered (supposedly bred) near Lake Baikal, Russia, showing that not all birds caught had been local ones. Same birds summered in southern and western Khangai mountain

This years (2017) autumn migration started in September and apparently the birds are taking the same route as in 2016. Currently some birds are already in China.

The migration of birds and its significance in the study of recent dynamics and history of Lake Baikal avifauna

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General trends of bird migrations to Baikal Siberia have not been revealed yet. Appearance of new species in the region is connected with age-old and centuries-old humidification changes and high water level. Some data about vagrant species on the largest part of Baikal Siberia are depicted in 74 works of 54 authors.
According to the composition of vagrant fauna in the region of Lake Baikal, Siberia, the majority of vagrant species are water birds. They make 11.4% of the whole bird fauna of Lake Baikal. The most numerous are representatives of Charadriiformes (14 species), Laridae (9 species), Anatidae (8 species), Ardeidae (2), Threskiornithidae (2), Gruidae (3), and Stercocariidae (3). The other families are less represented with only single species. Two peaks of registration of vagrant species of water avifauna were recorded: spring-early summer (May-June) and autumn- early winter (September-October). The largest counts of migrants are registered in May and June. We have to mention the influence of these birds on recent habitat dynamics history when during the period of Holocene with climatic optimum for the majority of water species lead to more extensive habitats. Due to glacier retreat and tundra zone offset to the northern breedings moved to higher latitudes. Some species, which are currently not represented in the breeding fauna of Baikal Siberia are likely to have habitat and nesting place there as their recent habitat is not far from the region under consideration. This explanation is quite logical for the majority of vagrant arctic species of Charadriiformes. Their appearance is of a residual relict character.

Factors determining the distribution and population status of the snow leopard (*Panthera uncia*) in Mongolia

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The main objective of the work is the identification of factors affecting the distribution and population status of snow leopards in western Mongolia. Materials obtained during field expeditions from 6 to 25 September 2013 in some areas of the Mongolian Altai: Jargalant, Bumbatkhaan and Baatarkhaan. All three areas are open for grazing, where cattle graze throughout the almost year-round.
The main material is collected by 18 research routes, a total length of 197.5 km,

and covered an area of over 7,000 square kilometers. We recorded on routes such traces of live snow leopard as scrapes, feces, urine marks, footprints and trace chain. To estimate the size and condition of the group, we took into consideration the following criteria: the intensity of marking territory scratched; character scrapes (clustering), the refresh scrapes and site visit.
According to data collected ounce distributed almost everywhere in the middle and upper mountain belt at an altitude of 1800-2000 to 3800 m above sea level.
The distribution of snow leopards depends entirely on the nature of the terrain and the distribution of the main species of the victims. In most parts of the investigated area is the main diet of the snow leopard in the summer season is the marmot (more than 50% of meetings) and Ibex. In the mountains Jargalant, where the number of Siberian ibex is somewhat higher than in other areas, as a factor of concern is strongly expressed in the summer snow leopard follows the Siberian ibex in the upper mountain zone. For all three areas, the density of labeling area increases from the periphery to the center of the mountain range: For example, on a ridge Jargalant from 4 to 17 scrapes / km (on the peripheral part of the group) and from 21 to 44 scrapes/km, the middle part of the ridge in the inner part of the group.
Grouping Jargalant includes at least 3-4 adult females, 3-5 adult males and 4-5 are not territorial animals. Only about 10-12 snow leopards. Grouping Bumbatkhaan - 3-5 individuals, grouping Baatarkhaan - 10-15 individuals.

Genomic data do not support the subspecies status of the Eurasian lynx from the Gobi desert

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The Eurasian lynx (*Lynx lynx*) occurs in three separate populations in Mongolia: in the north (area ranging from Khentii to Uvs Province), south (from Umnugobi to Gobi-Altai and Khovd provinces) and east of the country (Dornod Province). Three to five subspecies were distinguished by various authors within the territory of Mongolia. Based on hitherto accepted taxonomical subdivision of the species it

has been assumed that northern lynx population should belong to the *L. l. wardi*, *L. l. kozlovi*, and *L. l. wrangeli* subspecies, the southern lynx to the *L. l. isabellinus*, and the most eastern population to the *L. l. stroganovi* subspecies. We carried out genomic analyses of Eurasian lynx variation with samples collected throughout several populations of Eurasia, including 8 samples from Mongolia, based on whole mitochondrial genome sequences and more than 200.000 intergenic SNPs. Our results have shown that the samples from Mongolia (collected from the Khentii, Tov as well as the Umnugobi Provinces) belong to the same haplogroup of mitochondrial DNA along with samples from the Tuva Republic, Yakutia (Sakha) Republic and Far East of Russia. Moreover, although the samples from Umnugovi (supposed *L. l. isabellinus*) were most differentiated from the East Siberian populations based on the SNPs analysis, all the Mongolian lynx samples clearly clustered together with the other Asiatic lynx in species-wide analyses. The genetic differentiation of lynx samples from Umnugovi is thus not sufficient to support its subspecies status. Future work will address the evolutionary and ecological significance of the observed genetic differentiation.

Comparative phylogeography of the Mongolian region based on its mammals

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The periodic oscillations of glacial and interglacial periods in the Quaternary have a significant impact on formations of faunal communities. Particularly, refugia have played a crucial role in survival of the species diversity and diversification of particular populations as well. Some refugia were source of subsequent recolonization of regions or whole continents by specific taxa. The detection of refuge areas helps us to understand earlier conditions and biological processes, which had influenced recent diversity and species distributions. In the context of the entire Palearctic realm, one region seems to represent a very significant refugium: Altai-Sayan and the adjacent areas of Mongolia or China - especially for glacial species or so-called mammoth steppe fauna, specifically based on community composition of Pleistocene+Recent mammals and survival of particular species since the Late Pleistocene. Additionally, the current results indicate the peculiarity of the local populations (e.g. *Myotis*) and their source character for recolonization of adjacent regions (e.g. *Sorex*) as well.
Our research analyses basic phylogenetic and population-genetic parameters in selected species to find out the degree of diversification for subpopulations and

corresponding time of diversifications and links to other populations. We try to detect current and former factors responsible for diversifications of analysed species. Our preliminary data based on analyses of several selected species support the importance of Altai-Sayan-Mongolian region that has served as a refugee for tundra-steppe-desert elements (e.g. *Allactaga sibirica*, *Eolagurus luteus*) or even for species with a preference to forest vegetation (e.g. *Dryomys nitedula*), and source region for post-glacial colonization as well (e.g. *Microtus gregalis*). Whereas some species have much southern or south-eastern (mild/wooded) refugia (e.g. *Apodemus peninsulae*).

Study and conservation of vertebrate in the Uvs Lake basin - achievements of the last decades

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The Uvs Lake basin is the unique natural ecosystem that has a worldwide value recognized by UNESCO. The regional biota is studied by scientists from Mongolia, Russia, Germany and other countries. The results are regularly presented at scientific forums, including the International Ubsnur Symposiums (first was held 1989, the 13th - 2016). Two SPA have been created in the adjacent parts of Mongolia and Russia, which with a high degree of coordination are working to preserve the unique ecosystem and control the traditional forms of pastoralism. The results of studies, which are important for the conservation and sustainable use of the biological resources of the Uvs Lake basin, are presented.

*Mammal*s: A total of 66 mammal species inhabit the Uvs Lake basin. Three species of semiaquatic mammals (Eurasian beaver, American mink, muskrat) are introduced and successfully naturalized. The main driver of success of mink invasion was muskrat. The three-time introduction of the Central Asian beaver is made to reduce the risk of loss of the autochthonous gene pool, now – in the Mongolian Red Book (2013), the Red List of China's Vertebrates (2015) and the Red Book of Tyva Republic (2017).

Birds: A total field study, carried out in recent years, has expanded the list of birds

of Uvs Lake basin to 345 species, including 309 nesting, 4 winter migrant, and 32 transmigrant. Nesting of the Relict Gull and other threatened bird is recorded. The global population growth of the Great Cormorant is followed by its increasing presence at Uvs Lake as well. Cormorants consume up to 1,800 tons of fish per season, which causes degradation of relict forests around nesting colonies.
Amphibians and reptiles: There are one species of amphibians and 7 species of reptiles within the Uvs Lake basin. Findings of the Siberian Salamander within the Mongolian and Tuva territories widened the range of this endemic species of Asia.
Fishes: The water bodies of the Uvs Lake basin inhabit 7 species of fishes. The ichthyomass is represented mostly by the Altai Osman. Recent molecular and genetic studies have made it possible to clarify the taxonomic status of fish species and more reliably determine the zoogeographical position of the Uvs Lake basin.

Current insights into the phylogeny, morphology and ecology of Mongolian long-eared bats (*Plecotus* spp.)

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The Palaearctic can be considered as the zoogeographic region with the most comprehensive information regarding the taxonomy, distribution, and ecology of bats (Chiroptera). However, for many Palaearctic sub-regions, such as Mongolia, detailed information for these interesting mammals is still lacking. Mongolia, a large and sparsely populated country, is characterized by extreme climate conditions and an enormous ecological as well as geographical diversity. Thus, it can be expected that the diversity of bats on species or subspecies level is not yet fully discovered despite an increasing number of studies in the past decades. In particular for low-distance migrating bat species, such as species of the genus *Plecotus*, local populations may exists that are genetically and morphologically distant to the yet described species.
With the preliminary taxonomical revision of the genus *Plecotus* by Spitzenberger et al. (2006) a fundamental basis and necessary prerequisite has been created to revisit the taxonomy and ecology of Mongolian long-eared bats (*Plecotus*). Initial work had already been published summarizing the current knowledge.
Here we present our recent investigations and results towards the phylogeny,

morphology and ecology of Mongolian *Plecotus* species. For this, specimen material from three different sources were genetically and morphologically examined, namely (I) material obtained from joined Mongolian-German Biological Field Expeditions since 1962, (II) material from field expedition by Stubbe & Stubbe, and (III) our joined field expeditions (1999-2014) of the Landesfachausschuss Säugetierkunde Brandenburg & Berlin together with Mongolian colleagues. Genetic analysis based on mitochondrial 16S RNA and ND1 gene in conjunction with morphological and cranial characteristics encourage us to propose a novel *Plecotus* species inhabiting semi-arid areas of Mongolia. Furthermore, a cryptic sub-species may occur in the Eastern steppe are as revealing moderate genetic but large cranial distance to *P. ognevi*. We will discuss these recent results in the context of taxonomy, distribution and ecology of Mongolian long-eared bats and further outline our ongoing efforts to contribute and thus further increase our knowledge regarding the Chiroptera of Mongolia.

Movements and range sizes of goitered gazelles (*Gazella subgutturosa*) in the Mongolian Gobi

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The Mongolian Gobi provides the world's largest populations of goitered gazelles (*Gazella subgutturosa*), yet expanding exploitation of natural resources, and the development of infrastructure in the region are placing increasing pressure on this species and its habitat.

To understand movement patterns and habitat use of goitered gazelles, 10 individuals were captured and fitted with GPS collars in October 2014. A total of 33,462 GPS locations fixes were collected for 8 animals until January 2016, excluding the locations for the 2 animals that were tracked for < 1 month. The average (± SD) distance travelled in 2h period was 0.68 ± 1.01 km, while the maximum distance travelled in 2h ranged between 7.2 km and 13.9 km among individuals. Cumulative travelled distances for the entire survey period exceeded 4,400 km. Male gazelles travelled a greater distance in 2h period (0.82 km; $t = -3.44$, $p < 0.001$) than females (0.73 km). The annual range sizes varied more than 7-fold between the gazelles (Mean = 2,498 km^2; range: 664 – 4,988 km^2). There was inter-annual seasonal range overlap in winter (e.g. October – January periods) for all gazelles. The average

seasonal range overlap for the collared gazelles was approximately 25% (range = 10 – 34%). Results from these monitoring efforts will be particularly important to enhance conservation of the goitered gazelles.

Genotyping by sequencing and analyses of geographic genetic structure to guide conservation of the world's largest salmonid, *Hucho taimen*

L. M. Galland, J. B. Simmons, S. Chandra, Z. S. Hogan, O. P. Jensen, and T. L. Parchman.

Genomics-enabled population genetic analyses stand to advance our understanding of evolutionary history, and to inform conservation of important aquatic vertebrates. *Hucho taimen* occur in Northern Mongolia and Russia, and are the largest and perhaps most endangered salmonids in the world. Little is known about natural genetic variation in these fish, with the exception of a few past studies based on relatively uninformative small sets of DNA markers with insufficient resolution for understanding genome variation across riverscapes. Understanding the geographic distribution of genetic variation across populations of taimen will be crucial for understanding the implications of the proposed construction of the Egiin Gol hydroelectric project, which could soon represent severe barriers to movement, reproduction, and dispersal. Here, we present a population genetic analysis of taimen from two drainages emptying into the Pacific and one emptying into the Arctic, spanning Mongolia and Russia. We genotyped ~300 individual fish from multiple river drainages at tens of thousands of single nucleotide polymorphisms (SNPs) using a genotyping-by-sequencing approach. Hierarchical Bayesian models were used to estimate allele frequencies and genotype probabilities, to quantify population structure and diversity, and to identify the geographic extent of gene flow. These analyses should improve our understanding of the evolutionary history of taimen and how fine-scale patterns of geographic genetic variation can inform development of the most effective and efficient conservation strategies for the world's largest salmonid.

Gobi Bear Research Project Goals and Results

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[1]*Gobi Bear Research Project and Gobi Bear Fund*

The purpose of the Gobi Bear Project is to assist the Government of Mongolia in its commitment to protected area management, and to promote conservation and

protection of a Critically Endangered species, the Gobi bear (*Ursus arctos gobiensis*). Established in 2005, the Gobi Bear Project team is comprised of over a dozen dedicated members, the majority of whom are Mongolian nationals and know the study area intimately.

Over the past decade, we have worked hard to develop our understanding of this important animal. We have been able to fit 20 bears with GPS tracking collars so we can better understand their behavior and movements through this incredible landscape, and significant work has been done to develop our knowledge of their genetics, reproductive performance, survival rates and more.

Gobi bears primarily live around three oases within the GGPSA, located around Atas Bogd Mountain, Shar Khuls Oasis, and Tsagaan Bogd Mountain. Each oasis complex is comprised of seven or more springs, separated by about 70-100 km of pure baked pancake flat gravel from the adjacent complex.

Gobi bears are listed as Critically Endangered in the Mongolian Redbook of Endangered Species, the Zoological Society of London and the IUCN Bear Specialist Group. This assessment was based on estimates that the population included less than 50 adult animals, and were separated by enough distance from other closely genetically-related populations that immigration/emigration would not reasonably be expected to occur. It is included as an Appendix I Species (Critically Threatened with Extinction) under the Convention on International Trade in Endangered Species (CITES), to which Mongolia is a signatory country. No Gobi bears are known to exist in captivity anywhere in the world.

Since 2005, the Gobi Bear Project has been engaged in a range of activities to promote the survival of this incredibly unique species. Although shy and very difficult to capture, to date we have managed to fit 20 individuals – 15 males and 5 females – with GPS satellite radio collars. Combined with genetic hair analysis, this has enabled us to build up an understanding of how these bears move in and utilise their landscape, and thus enable us to determine how their behavior relates to their survival.

The house mouse, *Mus musculus* in Mongolia - taxonomy, status and ecology of a neglected species

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Although the house mouse as a common and widely-distributed species and probably best-studied among small mammals, there is a lack of fundamental knowledge regarding species identity, morphology and ecology in Mongolia. Consequently, this study provides first results of basic biological research on the Mongolian house mouse. A total of 184 specimens have been studied based on samples collected during the period 1962 to 2016. Using genetic and morphological markers, the taxonomic examination resulted in classification as *Mus musculus musculus* Linnaeus, 1758. To characterise the Mongolian house mouse, three fur colour traits and 23 metric body and skull traits were analysed. On the basis of the visual habitus, the geographical distribution was highlighted. Two obviously different morphotypes were identified: (1) light individuals with a distinct demarcation line which occur in most parts of the country, (2) dark individuals with a diffuse demarcation line which are mainly found in the northern part of the Selenge province. Furthermore, these morphotypes differ in five metric body and skull traits. In general, Mongolian house mice seem to be consistent with reference specimens from Eastern Europe according to metric traits, although exhibiting a shorter tail. The sex ratio of the Mongolian house mouse was determined at 1 : 1.3 in favour of males. An analysis of age structure showed comparatively low mortality rates, presumably because of the small sample size. The reproduction status reflects a good physiological condition of dams with a mean litter size of 6.8 pups. As known from literature, *Mus musculus musculus* lives hemisynanthropically, which can be confirmed for Mongolia as well. Specimens were collected in human settlements, but also in natural habitats such as oases, dunes and lake shores. The cohabitation with other rodents, which are competitors for food and nest, is discussed. Lastly, the genetic characterisation of populations was determined by using non-metric cranial traits. Three main populations were exposed: north-central, south-east, and west. The latter seems to be more isolated from the other populations, probably due to the Altai Mountains as a natural barrier. The western, southern, and eastern populations show lower values of fluctuating asymmetry (6.5 to 9.0%), than the northern and central populations (11.5 to 13.1%). Therefore, the latter seems to be more influenced by stress factors. The resulting mean measure of divergence values of the Mongolian house mice were rather low in comparison to other rodents, which indicates that house mice are quite talented in terms of dispersal. A possibly important role for the passive distribution of house mice is that of the nomads, who have travelled the country for a long time. Large knowledge gaps about the Mongolian house mouse still remain for further study, especially issues of distribution, initial colonisation, and ecology.

Helminth fauna of birds in Mongolia

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Parasitic helminthes of the birds in Mongolia remain largely unknown. The first report was that of Petrov and Ivashkina (1959) on a parasitic nematode from great bustard (*Otis tarda)*.
After that work, during period from 1961 to 1972, Mongolian parasitologist G. Danzan performed a wide range of investigations that involved more than 1032 individuals belong to 105 species of birds. In total, G. Danzan reported 119 species, including 6 species of trematodes, 66 species of cestodes, 6 species of acanthocephales and 41 species of nematodes.
Lately, investigations on bird parasites were conducted by the staff of international expeditions, such as Mongolian-German biological expedition organized by the Mongolian State University and Halle-Wittenberg University named after Martin Luther (Germany); the joint Mongolian-Soviet complex biological expedition of the Mongolian and Soviet Academies of Sciences; the joint Mongolian-Soviet Huvsgul complex expedition of the Mongolian State University and Irkutsk State University (USSR).
In the present work, a check-list of all helminth parasites recorded from domestic and wild birds in Mongolia was compiled based on available records published in Mongolia and abroad. Also, unpublished original data on bird helminths is included. A total of 187 helminth species (15 species of Trematoda, 94 species of Cestoda, 69 species of Nematoda and 9 species of Acanthocephala) from 103 species of host species is listed. The helminth fauna of the Mongolian birds is still remain understood incompletely. For example, only in Mongolian fishes registered 21 species of trematodes (Perenleijamts, 1993), which are completed life cycle with birds. However, the definitive hosts for most of them are still in question. In the present check-list, helminths were recorded from 103 species of birds, this number is constitutes about one-fourth of the total avifauna of Mongolia, only.

Blood parasites of Fishes of the Lake Baikal basin

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Parasitic protozoans inhabiting the blood of fish are widely distributed and currently have been of great interest from researchers in connection with their diversity and

pathogenicity for hosts. Infected fish develop anaemia, anorexia, exophthalmia, abdominal distension with ascites, general edema, and splenomegaly.
Parasitic protozoans of the genera *Trypanosoma, Trypanoplasma* (=*Cryptobia*) (Kinetoplastidea) and *Haemogregarina* (Sporozoa) were found in the blood of fish in the Lake Baikal basin. 8 species of trypanosome were found in the 10 species of fish in the Lake Baikal, 5 species of trypanoplasme in the 14 species of fish and 1 species of haemogregarina in the 1 species of fish (Khamnueva, Pronin, 2001; Khamnueva, Baldanova, 2016). Trypanosome infects predominantly littoral fish species and is found in the blood of cottoid fish caught at a depth of up to 350 meters. Fish infected with trypanoplasme occur from the littoral to the abyssal (up to 1100 м). Haemogregarina is found in the coastal part of Lake Baikal only at the sand sculpin, *Leocottus kesslerii*.
In the Russian part of Selenge River trypanosomes are found in *Perca fluviatilis*, and in mongolian part – in *Brachymystax lenok* (Khamnueva, 2001; Mazur et al, 2014). In the Selenge basin in Mongolia trypanosomes were found in the *Perca fluviatilis* in the Lake Ugii, in the *Thymallus nigrescens* in the Lake Khuvsgul, and both species of flagellates found in the *Leuciscus idus* in the Orkhon River (Mazur et all, 2014). Blood parasites are found in the smears of fish blood singly, but there are fish with a very high intensity of invasion.

A New Species of *Catenotaenia* (Cestoda: Catenotaeniidae) from *Pygeretmus pumilio* Kerr, 1792 from the Gobi of Mongolia

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From 1999 through 2012, a total of 541 individual rodents (jerboas of the family Dipodidae) were collected by and examined for helminth and protistan parasites from several habitat types, primarily from Gobi region of Mongolia. Of these rodents, 25 were identified as *Pygeretmus pumilio* Kerr, 1792 (Rodentia: Dipodidae) 516 were other species of jerboa from the provinces of Dornogobi, Dundgobi, Umnugobi, Uvurhangai, Bayanhongor, Gobi Altai, and Hovd. During our field

work, we collected several cestodes, some of which represented undescribed species, and these new species occurred in 40% of *P. pumilio* from four separate collecting localities. We designate this new species as *Catenotaenia tuyae* n. sp. (Cyclophyllidea: Catenotaeniidae) which is characterized by having relatively long and narrow gravid proglottids and an ovary in mature segments that is located antiporally in the anterior portion of the mature proglottids. In addition, the position and the ratio of the genital pore toward the anterior end of the proglottids are unique and the ovary is elongate, being confined to the antiporal part of the mature proglottid. These morphological features are supported by molecular phylogenetic evidence using the 28S rRNA gene, and serves to differentiate *C. tuyae* from all other species in the genus included in the phylogenetic analysis. The intensity of *C. tuyae* infection in *Pygeretmus* ranged from one to three individual cestodes per infected host.

Parasite fauna of Siberian Dace, *Leuciscus leuciscus baicalensis* from rivers of Selenge river basin in the territory of Mongolia

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Parasitic organisms are important components of the taxonomic and ecological diversity of ecosystems. The Selenge River is the main and one of the longest tributaries of the Lake Baikal.

Object of research is Siberian Dace are widely distributed in the rivers with the moderate current of the Siberia. We investigated the parasite fauna of the dace *Leuciscus leuciscus baicalensis* from July-August 2005 to June-July 2013. Fishes were caught by nets in Selenge River (49°22’86.6-84.1”N 103°36’82.9-84.3”E) and (50°04’21.4”N 106°51’50.5”E); Orkhon River (48°37’24”N 103°32’38”E) and (50°13’73.8”N 106°11’91.1”E) in 2015; Egiin-Gol River (50°03’20.0”N 101°28’57.5”E) and Eroo River (49°51’09”N 106°18’23”E). In total, 44 parasite taxa were collected from *L. l. baicalensis,* including 3 protozoans, 11 myxozoans, 6 monogeneans, 4 cestodes, 9 digeneans (5 as metacercariae), 4 nematodes, 1 acanthocephala, 1 hirudinea, 5 crustaceans, 1 glochidia. Two species were ranked as core species, which found in all water flows: the myxozoan *Myxidium rhodei* with prevalence values from 33,3% to 93,3% and metacercariae *Diplostomum spp.* with prevalence values from 86,9 to 100%. Parasites noted in all studied rivers are *Tylodelphus clavata* (13,3%-69,5%) – intermediate species and *Myxobolus muelleri* (6,7%-20%) – sattelite species. Distribution of parasites by sampling sites showed approximate uniform distribution of parasites (25-24 species) at stations Selenga station1, station 2, Orkhon station 2. A significant reduction in the species diversity

of 15-11 species at stations: Orkhon station 1, Egiin-Gol and Eroo-Gol.
Most of the species of parasites we have noted are parasites in general widely distributed in the Palearctic and are noted in the partial fishes in the delta and in the coastal zone of Baikal. The highest species diversity is observed among myxosporidia, trematodes and monogeneans. A relatively small number of cestodes are noted. In general, in the investigated regions, the dace was marked by a high diversity of parasites.

Helminths biodiversity of Mongolian racerunner, *Erenias argus* PETERS, 1869 in the Selenge river basin

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Reptiles perform important functions in natural ecosystems as predators, prey for predators, pasture inhabitants, they serve as bio-indicators of environmental conditions (Böhm et al., 2013). The Mongolian racerunner, *Eremias argus* occurs in eastern Mongolia, China, western part of the Korean Peninsula, and Russia. In Russia this racerunner is distributed in southern Buryatia (Selenge river basin) and southwestern part of the Zabaikal'skiy region (Ananjeva et al., 2004). The single helminthological study of the Mongolian racerunner within Zabaikalie was conducted by Sharpilo (1976).
Nine species of helminths including 2 species of cestodes, 6 species of nematode and one acanthocephalan worms were revealed from the Mongolian racerunner. The composition of the helminthes fauna of the Mongolian racerunner inhabiting discrete localities ranges from 2 species to 6 species. The dominant species in the helminthofauna of the racerunner was *Spauligodon pseudoeremiasi*, and subdominant species are *Oochoristica tuberculata* and *Abbreviata abbreviata*.
Eremias argus represents a new host record for *Oochoristica tuberculata, Mesocestoides lineatus, Abbreviata abbreviata and Macracanthorhynchus catulinus*. Mongolia is a new locality record for *Oochoristica tuberculata* and *Skrjabinelazia hoffmanni*.

Seasonal water use patterns of large mammals in the Tsagaan Bogd Mountain (Trans-Altai Gobi, Mongolia)

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Acquiring water is essential for all animals, but doing so is most challenging for desert-living animals. The Trans-Altai Gobi is the largest remaining of the rare mammals of the Central Asian desert. There are few natural springs and oases. In these arid environments, water sources can be efficient sites for placing camera traps. We estimated the water use patterns and settlements of large mammals in the Gobi Desert. We used 41 automatic camera traps to document wildlife use at 7 natural springs in the Tsagaan Bogd mountain area from May 2015 to June 2017. For each visitation, we recorded time of day, season of use, and activity.
We collected a total of 651707 pictures and documented 12 species of large mammals from 7 families using the water sources. Most of these species visited the springs year-round with use peaking during November and March. We concluded the springs are more important for desert mammals during these drier times when the vegetation is dry, and there is no snow. Gobi bears were most used water sources in spring and summer, but in autumn they visited less the water sources. During this time, the main food fruits of some shrubs can be provided the water requirement of Gobi bears. The other carnivores are visited springs randomly with no seasonal differences.

Contribution of Prague Zoo to the Przewalski‘s horse conservation efforts, its reintroduction to Mongolia, and future prospectives

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For 85 years, the Prague Zoo has been involved in the conservation of the Przewalski’s horse and for the last 25 years, with its reintroduction into Mongolia. Breeding of this species at Prague Zoo dates back to 4th October 1932, when the stallion Ali and the mare Minka, originally from German Halle, were brought from a school farm in Netluky near Prague. The first foal was reared in Prague in 1933, and the local breeding continued unaffected throughout the World War II. After 1945, Prague Zoo was one of the main bases for the revival of the Przewalski’s horse population in captivity. Prague Zoo also played a significant role in coordinating international

conservation efforts. During the first world symposium on takhi conservation held in Prague in 1959, Prague Zoo was entrusted with the world studbook of the Przewalski's horse. In the early 1990's, the first studbook keeper, Dr. Jiří Volf, helped Christian Oswald acquire Przewalski's horses for Takhiin Tal. Several horses were also transported from Prague to Mongolia that time. In 2011, Prague Zoo commenced the reintroduction of the Przewalski's horse to the Great Gobi B SPA. Over seven years, CASA army aircraft transported to western Mongolia, a total of 27 takhis originating from several breeding facilities in Europe, and 4 other horses were transported by air from within Mongolia. Prague Zoo invests a lot of effort and resources into the support of SPA Great Gobi B and nearby communities. For example, Prague Zoo renovated a hospital in the village of Bij; purchased several cars for Great Gobi B rangers; constructed haylofts and guard posts; and drilled a well in Takhiin Tal. In the future, Prague Zoo plans to continue airlifts of the Przewalski's horses from Europe to the Great Gobi B SPA and support development projects. Furthermore, Prague Zoo will increase its support and implementation of research activities in this region.

The Myriapods (Chilopoda and Diplopoda) of the Khentey-Mountain Range. Communities from different forest-types under a varying fire regime

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We sampled 99 plots in three locations in the West, South and East Khentey, each consisted of either pitfall traps and soil and litter sampling. We were able to establish the occurrence of ten species of Chilopoda and three species of Diplopoda in the Khentey-Mountain region.

Among the Chilopoda we found eight Lithobiomorpha *Lithobius (Ezembius) giganteus, Lithobius (E.) sibiricus, Lithobius (E.) ostiacorum, Lithobius (E.) rapax, Lithobius (E.) mongolellus, Lithobius (Monotarsobius) alticus, Lithobius (M.) crassus* and *Lithobius (M.) curtipes* and two Geophilomorpha *Escaryus chadaevae* and *Strigamia pusilla*. *L. giganteus* and *L. alticus* were by far the most widespread Chilopoda-species.

Three Diplopoda species were *Angarozonium amurense*, *Orinisobates microthylax* and *Uniramidesmus perplexus*, with *A. amurense* as the most abundant species.

Both the genus *Orinisobates* and *O. microthylax*, as well as the family Nemasomatidae they belong to, are new to the millipede fauna of Mongolia. Being the southernmost find of *U. perplexus*, the current record is new to the Mongolian millipede species list, likewise the genus *Uniramidesmus*, the family Polydesmidae and the order Polydesmida.

The Chilopoda-communities in the West were more species-rich than those in the South and East, which is caused by the higher precipitation and hence resulting higher diversity of the forest. Even within the Western and Southern Khentey, we found a simultaneously increase in the richness of Chilopoda and tree species. Generally, we found the highest diversity of Chilopoda in the higher altitudes, which corresponds with the increasing precipitation, and, exclusively for the Lithobiomorpha, in the floodplain forests. Geophilomorpha were absent in the alluvial forests and were only found in the hill forests.

Diplopoda occurred only within the West and East, while in the dry Southern Khentey, no Diplopoda can be found and their occurance seems lacking or very rare.

Regarding the influence of fire, the situation is more complex. The two most common Chilopoda-species are indiscriminately found on burned and unburned areas, while significantly less common species such as *L. sibiricus* have their peak of abundance in burnt areas. The soil-dwelling Geophilomorpha showed no clear differences with regard to the fire influence, and so do diplopods.

A preliminary survey of freshwater gastropods of Mongolia

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The fauna of the freshwater snails (Mollusca: Gastropoda) of Mongolia is still underexplored. There is no even a more or less complete check-list of Gastropoda inhabiting the Mongolian waterbodies. The authors made field surveys of Mollusca and other aquatic macroinvertebrates of Mongolia from 2010 to 2014. The examination of the materials collected as well as those available in museum collections (mostly kept in Russian zoological institutions) made it possible to compile the first check-list of freshwater snails of this country. It is of preliminary character, since the taxonomic validity of some species needs a re-assessment by means of the molecular analysis. In total, 35 nominal species of snails belonging to four families (Valvatidae, Lymnaeidae, Physidae, and Planorbidae) have been

included into the final list, with remarks on their distribution, ecology, taxonomic status, and nomenclature. The fauna of freshwater Gastropoda of Mongolia is taxonomically impoverished as compared to the fauna of southern Siberia and other adjacent areas. In particular, no representatives of such families as Acroloxidae and Bithyniidae were found to live there as well as no species of *Anisus, Aplexa, Planorbarius*, *Planorbis, Stagnicola* and some other genera of aquatic snails broadly distributed in the Palearctic. From the zoogeographic point of view, the recent fauna of aquatic Gastropoda of Mongolia consists of species belonging to three diversification centers, northwestern Palearctic, Siberian, and Central-South Asian. The only species endemic to Mongolia is *Choanomphalus mongolicus* inhabiting the Hövsgöl Lake. A brief history of formation of the recent Mongolian fauna of freshwater snails will be discussed. The full version of the check-list, with shell descriptions and illustrations as well as with discussion of taxonomic and nomenclatorial topics will appear in journal *Zootaxa* in 2017.

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Environmental drivers of diversity patterns in the Coleoptera of the Altai Mountains

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The Altai Mountains located in western Mongolia comprise diverse habitats including forest, mountain steppe, dry steppe, semidesert, and desert. We used advanced statistics to examine how diversity and species composition of beetle communities depend on vegetation pattern and environmental factors along an ecological gradient from steppe to desert. The beetle families Tenebrionidae, Carabidae, Curculionidae, and Coccinellidae account for the majority of the known beetle fauna in the area. The most abundant Coleoptera in all plots were *Harpalus limbaris*, *Corsyra fusula*, and *Anatolica cellicola*; otherwise, we caught a large number of rare species. The beta diversity of communities was correlated with distance between plots. Species richness of beetles was positively impacted by plant cover and correlated negatively with rising temperatures, whereas Shannon diversity of beetle communities was

significantly higher in areas with higher precipitation. Distribution and community composition of Coleopterans were governed by environmental factors, especially plant diversity, mean annual temperature, and summer precipitation, as revealed by redundancy analysis.

Phylogenetic diversity of actinobacteria of the genus *Amycolatopsis* isolated from soil and lichens of Mongolia

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Unique nature and biodiversity of Mongolia have attracted many local and foreign researchers to study their peculiarities and discover new species of living organisms. Among them the Mongolia-Japan joint research project "Taxonomic and ecological studies of microorganisms in Mongolia and its utilization" for the first time has investigated the microbial diversity of Mongolia on a molecular level. Here we present the phylogenetic diversity of actinobacteria of the genus *Amycolatopsis* revealed by analysis of 16S rRNA gene sequences. Representatives of this genus are known for production of such medically important antibiotics as rifamycin and vancomycin. They produce L-asparaginase used for treatment of certain human cancers, mainly acute lymphoblastic leukemia. Their resistance to heavy metals is considered to be of interest in bioremediation of polluted environments. The isolation of actinobacteria was carried out from 15 soil samples collected in Khuvsgul, Uvs, Selenge and Umnugobi provinces as well as from 8 lichen samples collected in Khuvsgul and Central provinces. The phylogenetic analysis indicated that 29 isolates were members of the genus *Amycolatopsis* and had 97.98-100% similarity to earlier validly published species. Soil and lichen isolates were phylogenetically different. Significant differences in diversity of soil isolates were found in Khuvsgul and Uvs provinces. By their phylogenetic positions most isolates represented novel centres of taxonomic variation and, therefore, can be used for screening of new bioactive natural products and proposal of new species of the genus.

Bioaccumulation of heavy metals by aquatic macroinvertebrate and fish fauna in different reaches of the Kharaa River, Mongolia

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The Kharaa River basin plays an important role in the regions freshwater habitat functioning. Under different projects water quality monitoring programs have been intensively conducted in the Kharaa River Basin. The Institute of Geography and Geoecolgy (formerly Institute of Geoecology), Mongolian Academy of Sciences has implemented three basic research projects funded by the Mongolian Foundation for Science and Technology since the year of 2009. Within the framework of these projects, heavy metal bioaccumulation has been addressed. This work presents the concentrations of heavy metals (Cr, Co, Cu, Pb, As, Cd, Hg, Se) in macroinvertebrates (*Ophiogomphus obscurus*), fishes (6 species), water and sediments in the different reaches of the Kharaa River. The results show that increased levels of arsenic and mercury in water and sediment were detected in the tributaries Gatsuurt and Boroo Rivers demonstrating the adverse impacts of gold mining. The survey on bioaccumulation of heavy metals by aquatic macroinvertebrate covers only one year research work and requires repeated measurements. The levels of heavy metals varied significantly among fish species and organs including livers, gills, and muscles. In most studied fish, the liver was the target organ for Cu, Fe, and Zn accumulation. Generally, certain recorded metal concentrations in fish tissue exceeded the internationally recommended threshold (EPA) while the results from aquatic macroinvertebrates were within the range.

Intraspecific variation of the steppe species *Camelina microcarpa* and *Sisymbrium polymorphum* (Brassicaceae): Seeds size, relative genome size, and molecular analyses

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The genus *Camelina* belongs to the tribe Camelineae in the Brassicaceae family. *Camelina microcarpa* is a widely established annual to biennial species in steppes, on stony slopes, and as a weed along roadsides and in arable fields. It is a self-compatible and predominantly selfing species (own studies). Migration of *C. microcarpa* from disturbed areas to xerothermic grassland habitats was described by Eliás (2003). It is supposed that the genus *Camelina* originated in the steppes of southeastern Europe and southwestern Asia and extended its range to western and eastern Siberia and Central Asia.

Sisymbrium polymorphum occurs in steppes, meadows, rubble, and rocky slopes and sandy limestones, sometimes as a weed. It is distributed from eastern Siberia, Central Asia to European Russia and bordering regions.

Molecular phylogenetic studies indicate that the genus *Sisymbrium* is polyphyletic and is divided into three major clades, one of these is the "Old World" Clade. So far, *S. polymorphum* has not been included in molecular systematic analyses.

Here we will present first results of intraspecific variation over the whole distribution range. In a morphologic analysis we measured seed length and seed width of 13 *Camelina* and 11 *Sisymbrium* provenances. Chromosome counts and flow cytometric data achieved new insight in ploidy levels. Molecular analyses of nuclear marker (ITS) and plastidic markers (trnH-psbA, trnL-trnLF, trnQ-rps16) indicate high intraspecific variability.

The WATERCOPE project: research based policy recommendations for rural development in the Western Mongolian Altay

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WATERCOPE is a Mongolian-Sino-German project consortium bringing together researchers, herder and farmer organizations as well as policy makers and planners at different levels. Our common goal is to develop, compare and test-implement technologies to better cope with climate change effects on scarce agroecological resources in the vulnerable steppe and semi-desert ecosystems of the Altay Mountains and the Dzungarian Desert Basin (Altay-Dzungaria).
Due to its remoteness and harsh environmental conditions, the Dzungarian Basin and Altay Mountains of Mongolia did not receive much political and scientific attention. This and the pressing need for the development of effective strategies to enhance the livelihoods of poor transhumant herders made the Bulgan Sum government to greatly welcome the Mongolian-Sino-German WATERCOPE initiative since 2011. The local government actively participated in problem identification, project mid-term evaluation workshops and administrative consultations in Mongolia and Germany. Recently, the Bulgan River Basin Administration staff started to implement part of WATERCOPE´s science-based recommendations in a new River Basin Water Resources Management Plan. In this plan, improved herder adaptation to the effects of climate change, floodplain ecosystem degradation, drinking water insecurity and weak institutional cooperation were tackled as key administrative problems. Since the new management plan is based on comprehensive stakeholder participation, we believe it will become a useful and dynamic guideline to strengthen sustainable, pro-poor policies for local herders. Some results of the research and related policy recommendations will be presented for a discussion.

Relict plant species and conservation status of the vascular flora of Mongolia

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The Herbarium (UBA) at the Department of Botany, Institute of General and Experimental Biology, Mongolian Academy of Sciences and Herbarium (UBU) at the Department of Biology of the National University of Mongolia were checked for new findings and the material was partly critically revised. The present checklist is based on "*New conspectus of the vascular plants of Mongolia*" and were compiled in the Database of the Mongolian Flora as the basis for this checklist.

The about floristic findings of checklist of relict plant species to the vascular flora of Mongolia, which was on the species level have been made by new book of the "*Conspectus of the vascular plants of Mongolia*". At present, a total of 70 species (including 2 varieties and subspecies) are relict species (2.2%) of Mongolia belonging to 36 genera and 23 families. The families and genera that are richest in relict species are *Tamaricaceae* (10 species), *Fabaceae* (6 species), *Zygophyllaceae* (6 species) families and *Tamarix* (9 species), *Zygophyllum* (6 species), *Ephedra* (5 species) and *Calligonum* (5 species) genera (Tables 1, 2). The article reports on the new records of 3 species (*Amygdalus pedunculata* Pall., *Hippophae rhamnoides* subsp. *turkestanica* Rousi, *Peganum nigellastrum* Bunge) in Mongolia since Gubanov's conspectus (1996).

The areas in the south and west part (East Gobi, Dzungarian Gobi, Trans Altai Gobi, Alashaa Gobi) of Mongolia show the highest richness of known relict vascular plant species with 31 to up species per region. The lowest species numbers are found in some of the dry phytogeographical regions, viz. the Foothills of Great Khingan, Khovd and Khovsgol, East Mongolia with a range of 0 to 10 species per region .

The relict include 23 species (*Abies sibirica, Ephedra equisetina, Nuphar pumila, Nymphaea candida, Anticlea sibirica, Allium obliquum, Adonis mongolica, Iljinia regelii, Zygophyllum potaninii, Populus euphratica, Ammopiptanthus mongolicus, Caragana tibetica, Halimodendron halodendron, Spongiocarpella grubovii, Potaninia mongolica, Elaeagnus angustifolia, Peganum harmala, Lancea tibetica, Incarvillea potaninii, Physochlaina albiflora, Brachanthemum mongolorum, Saussurea involucrata, Tugarinovia mongolica*) as "very rare", 12 species (*Nymphaea tetragona*, *Allium altaicum, Kobresia robusta, Tamarix hispida, Calligonum gobicum, C. junceum, Zygophyllum gobicum, Z. rosowii var. latifolium, Astragalus dshimensis, Amygdalus mongolica, Lycium potaninii, L. truncatum*) as "rare", and 3 (*Adonis mongolica, Physochlaina albiflora, Brachanthemum mongolorum*) species as "endemic", 14 species (*Allium altaicum, Calligonum gobicum, Salsola passerina, Zygophyllum gobicum, Z. potaninii, Ammopiptanthus mongolicus, Spongiocarpella grubovii, Amygdalus mongolica, Potaninia mongolica*) as "sub-endemic", and 2 species (*Elaeagnus angustifolia, Tamarix ramosissima*) as "alien plants".

A total 28 species (*Abies sibirica, Ephedra equisetina, Nuphar pumila, Nymphaea candida, N. tetragona, Anticlea sibirica, Allium obliquum, Kobresia robusta, Adonis mongolica, Tamarix hispida, Iljinia regelii, Zygophyllum potaninii, Populus euphratica, Ammopiptanthus mongolicus, Caragana tibetica, Halimodendron halodendron, Spongiocarpella grubovii, Amygdalus mongolica, Potaninia mongolica, Elaeagnus angustifolia, Peganum harmala, Lancea tibetica, Incarvillea potaninii, Lycium truncatum, Physochlaina albiflora, Brachanthemum mongolorum, Saussurea involucrata, Tugarinovia mongolica*) is listed in the "Mongolian Red Book (2013)".

This includes 4 species (*Allium obliquum, Elaeagnus angustifolia, Lancea tibetica,*

Brachanthemum mongolorum) that are listed as "Critically Endangered (CR)", 12 species (*Abies sibirica, Nuphar pumila, Nymphaea candida, N. tetragona, Adonis mongolica, Zygophyllum potaninii, Ammopiptanthus mongolicus, Caragana tibetica, Spongiocarpella grubovii, Amygdalus mongolica, Incarvillea potaninii, Saussurea involucrata*) listed as "Endangered (EN)", 9 species (*Ephedra equisetina, Allium altaicum, Kobresia robusta, Iljinia regelii, Populus euphratica*, *Astragalus dshimensis, Halimodendron halodendron, Peganum harmala, Tugarinovia mongolica*) as "Vulnerable (VU)", one species (*Potaninia mongolica*) as "Near Threatened (NT)", one species (*Anticlea sibirica*) listed as "Least Concern (LC)", and one species (*Physochlaina albiflora*) listed as "Data Deficient (DD)" in the Mongolian Red List Book to the vascular flora of Mongolia by IUCN criteria.

Flora and vegetation in the Lake Dayan region of the Altai and the pollen morphology of some plants

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From 2010 to 2016, we collected dominant plants in the Sagsai soum, Bayan-Olgii province. Six sites were chosen in three type of habitats: 1) edge of forest, 2) forest interior, and 3) upper steppe in the lower mountain slope. Each site was subdivided into three plots. Geobotany records were made and collected, including 155 species of 85 genera, 30 families. The samples were processed by preparing herbarium specimens. Species were identified using the identififcation keys of Grubov (1982), Ulziikhutag (1985), and Busin (1979). Geobotany records for were made using the method of Drud (1940) and Walter (1982).

Geobotany record were made and plant samples were collected and identified in 18 plots distributed over six sites near the Lake Dayan (Saigsai soum, Bayan-Olgii aimag).

According to the pollen morphology results, pollen grain shape, size, groove, external pore, exine structure and surface patterns were substantially different between *Viola altaica* L., *Draba sibirica* L., *Llyodia serotina* (L.) Reichb, *Callianthemum sajanense* (Rgl.) Witasek, *Cortusa Brotheri* Pax., *Lagotis integrifolia* (Willd.) Schschk., *Lagotis integrifolia* (Willd.) Schischk., *Trifolium repens* L., *Agromonia pilosa* Ldb., and *Filipendula ulmaria* (L.) Maxim.

Effect of forest fragmentation on the epiphytic lichen richness and diversity of Larix trunks in the Tarbagatai mountain range, Mongolia

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The forest-steppe ecotone of Mongolia is characterized like others in mountainous terrain, by a mosaic of boreal forest patches at the moistest places on north-facing mountain slopes and grasslands on south-facing slopes. Forests dominated by *Larix sibirica* and have been intensively fragmented by logging, and other human disturbances over time. This results in a highly fragmented landscape pattern.

Lichens are widespread in forests ecosystems where they may constitute an important component of the total biodiversity. Epiphytic lichens are well-suited model organisms to study edge effects, because they take up nutrients and water directly from the atmosphere. The increased extent of forest fragmentation or habitat isolation is one of several important consequences of the influence of increased livestock density in Mongolia. Therefore, it is important to know the size of the forest fragment which is necessary to maintain a high diversity of forest lichens.

The study of the influence of forest fragmentation on epiphytic lichens was carried out in differently sized forests near Tosontsengel (Zavkhan province, 48°45' N, 98°16' E, 1700 m a.s.l.) in the Tarbagatai Mountain Range protected area. The epiphytic lichens were studied in 15 forest stands of varying stand size classified into the following groups: small forest patches ($0.1<km^2$) that were located in either wide grassland-dominated area or forest-dominated area as well as intermediate ($0.1\text{-}1.0\ km^2$) and large patches ($1.1\text{-}5.0\ km^2$) in forest-dominated forest-steppe area. Data of ephiphytic lichen diversity were recorded from 320 trees of *Larix sibirica* with a stem diameter at breast height of $\geq$ 15 cm. These trees were from 30 plots of 20 m x 20 m. On each sample tree, all individual lichen species were recorded on the trunk in a height of 0-1 m above the ground. The cover of each species was estimated in percent. On the plot level, the following characteristics were evaluated: species richness, the total cover of lichens, and the cover of individual species of lichens.

In total, 133 species were identified. According to literature data, 146 lichen species occur on the trunks of the area. Thus, more than 90% of the potential biodiversity of lichens was found in the forests. 47 species were xeroid-mesophytes (35%), 8 species were xerophytes (6%) and other species were classified as mesophytes.

Differences in the species richness (α- diversity) of epiphytic lichens between small and large fragments of forests in the study area were tested with Tukey's Post Hoc Test ($P<0.01$). Totally, 98 to 102 species were found in the forest-dominated area, while 76 to 79 species were found in forests of the grassland-dominated area.

The most diverse composition of epiphytic lichens was found in forest stands of intermediate (F1, F2) and large size (F3, F4) in the forest-dominated area.. There were few dominant species including *Hypogymnia bitteri* (94), *H, physodes* (40), *Hypocenomyce scalaris* (32) and *Lecanora subintricata* (22), that represented 54% of the lichen cover. Thhe total cover of lichens, the total number of species, the average number of species increased with forest stand size, whereas the number of trees without lichens decreased. The total cover of lichens ranged from 0 to 94% (mean 10 %) of the lower trunk surface.

The species diversity of lichens was markedly different in the small fragmented forests (G) in the grassland-dominated area. In the forests of the grassland-dominated area, there were many trees without epiphytic lichens on the trunk bases. Most trees were inhabited by few small lichen thalli. Many typical forest lichen species were absent from the smallest forests in the grassland-dominated area. A relatively large number of dominant species was found, such as *Parmelia sulcata* (34), *Lecanora subintricata* (28), *Flavopunctelia soredica* (21), *Melanelixa fuliginosa* (21), *Hypogymnia bitterii* (17), and *Melanohalea exasperatula* (14), and represented 61% of the epiphytic lichen cover in the small stands of the grassland-dominated region. The total number of species per fragment varied from 23 to 46, with an average of 30 The most common species were *Cladonia fimbriata*, *Hypocenomyce scalaris*, *H. bitteri, H. physodes, Parmelia sulcata*, *Trapeliopsis granulosa*, *Bryoria fuscescens*, *Buellia punctata, Evernia mesomorpha, Lecanora subintricata*, which were present in all fragments and in over 30 plots. By contrast, 25 species were present in only one plot (e.g. *Basidina adastra*, *Calicium viride*, *Ramalina dilacerata, Chaenothecopsis epithallina*, *Physcia adsendens*, *P. subalbinea*, *Basidina adastra Caloplaca chlarotera*, *Cyphelium notarisii, Melanelia olivacea, Physcia adsendens, Xanthoparmelia taractica*)

Most rare and remarkable species were only found in large forests, suggesting an influence of stand continuity and microclimate stability on species diversity.

In all studied fragments, we revealed a tendency to decreasing numbers of lichen species with an increase edge effect. Moreover, the species diversity of lichens decreased with height above the ground

Effects of climate on the vitality of boreal forest at the treelines in different ecozones of Mongolia

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In Mongolia the distribution of steppe and forest is generally linked to climate and topography. The limiting climate parameters provide information for environmental modelling. Remote sensing data and gridded climate data were analyzed in order to identify the driving ecological factors for the distribution patterns of forest and steppe in Mongolia. Vegetation vitality derived from the normalized differentiated vegetation index (NDVI) was investigated for three ecozones with boreal forest (taiga, subtaiga, forest-steppe). The analysis focused on different subunits of forest and non-forested areas at the upper and lower treeline, which represent ecological borderlines of site conditions.

The upper treeline generally increases from 1,800 m a.s.l. in the Northeast to 2,700 m a.s.l. in the South. The lower treeline locally emerges at 1,000 m a.s.l. in the northern taiga and is rising southward to 2,500 m a.s.l. The latitudinal trend of both treelines is modified to a longitudinal trend in the east of the mountains ranges due to more aridity caused by rain-shadow effects. Less vital trees were identified by NDVI at both, the upper and lower treeline in relation to the respective ecozone. The mean growing season temperature (MGST) with a minimum of 6 °C and mean values of 7.9-8.9 °C was found to be a limiting parameter at the upper treeline but negligible for the lower treeline. The minimum of the mean annual precipitation (MAP) of 230-290 mm/y is an important limiting factor at the lower treeline but at the upper treeline in the forest-steppe, too. While the MGST is positively correlated with the MAP of the forest-steppe ecozone, this correlation turns negative in the taiga ecozone. The subtaiga represents an ecological transition zone of approximately 300 mm/y precipitation, independently from the MGST. Nevertheless, higher temperatures generally lead to higher vegetation vitality in terms of NDVI values.

Sensitivity of NDVI to climate factors by the different land covers types and relationship of NDVI, temperature, precipitation and soil water

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Temperature, precipitation, and soil water are the three main factors controlling vegetation growth. In order to clarify the geographical difference of the effect of air temperature, precipitation, and soil water on vegetation activity, correlation analysis was applied between NDVI and climate factors. Temperature is a main driver of vegetation activity. In many cases, higher temperatures have been shown to speed up plant development.

To identify the possible connection and sensitivities of different land cover type's NDVI local scale temperature, precipitation, and soil water, a regression analysis between NDVI and above climate factors was calculated. The correlation coefficient between monthly NDVI and monthly air temperature from 1982 to 2011 was calculated pixel by pixel. Further, a multiple regression analysis was performed to quantify the NDVI variance that can be explained by climate variables in different land cover types. The mean NDVI, temperature, and precipitation for the study area were plotted across eight land cover types.

In the Siberian region, most atmospheric precipitation that occurs over Siberia in the form of rain and snow are transported by air masses from the north or north-west. Second; over the Gobi desert region and north east Kazakhstan. In these two regions precipitation plays different way into effecting seasonal NDVI. West Siberian region, there is enough water supply occurred, contrary desert and dry regions precipitation are less coming.

Monitoring of spatio-temporal patterns of net and gross primary production and their responses to vegetation anomalies (NDVI) in Mongolia: assessment with MODIS datasets for periods 2000 – 2015

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A steadily raising temperature and landscape scale changes of vegetation patterns caused by natural and human induced factors in Mongolia. The objectives of

this study was utilize satellite datasets: MOD17A2/A3 and MODIS NDVI time series for better estimate large-scale of vegetation surveys in the eastern part of Central Asia. Also, it can be used to detect land degradation and restoration areas in Mongolia. Also, in fact that the vast territory of the Mongolian Ecosystem occupied by bare areas according on classification of LULC, and then with sparse vegetation. The estimation of Net and Gross Primary Productivity (NPP & GPP) from source MOD17A2/A3 would be beneficial to determine natural driver factors, whether on rangeland ecosystem is a carbon *sink* or *source*, such as a vast area of the selected zones incorporates exacerbate regional drought-risk factors nowadays. Generally, we have combined last available NPP & GPP (2000-2015) with 1 km resolution from MODIS, with investigation of long-term vegetation patterns under MODIS NDVI (250 m) satellite images within aim to estimate potential values of rangeland ecosystems.

15-year time series of NDVI with 16-day composite data proved and detected changes due to degradation, desertification, forest fires, deforestation and etc. Interaction ratios of NPP/GPP are integrating more accurately describe carbon sink process under natural or anthropogenic factors, specifically last results of NDVI trends were described as decreasing trends due to climate anomalies, besides the eastern and northern parts of Mongolia (mostly boreal forest zones) where accumulated or indicated of raising trends of NDVI in last three years (2012-2015).

Forest degradation issues in forest-steppe ecotone by livestock grazing in northern Mongolia

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Concern about global warming and increasing grazing pressure has become central issues in environmental policy decision-making and as a result much research has focused on pasture degradation in Mongolia. According to statistics, 61.5 million livestock (87% sheep and goat) were counted in 2016, which caused the degradation of 90 % of the pasture land in different ways.

The forest-steppe ecotone zone is potential pasture for these increasing livestock numbers in drought periods. Most forests (74%) are old-aged. Forested area has been converted to non-forested area at high rates during the last decades. Former forest inventories and studies often focused only on deforestation issues including fire, insects and logging, but left out forest degradation by grazing and edge fragmentation.

Here, we present ongoing research results that focused on grazing pressure and

risk assessment in the forest-steppe ecotone of the Mongolia. This research was based on the "Collect Earth –Open Foris" software, that is used in global land use change monitoring by FAO, and uses the systematic-plot point survey method for the analysis of high quality satellite images.
Additional case studies were made on livestock grazing impacts on larch forest expansion in the region of the Doroo-Tsagaan Lake from the Arhangai aimag (2017) and from the Altai Mountains from Bayan-Ulgii aimag (2013). Results suggested that strong negative consequences occur for the forest-steppe ecotone due to intensive grazing and livestock densities.
To solve problems related to increasing deforestation and heavy grazing impact further investigations should include the experimental research that focuses on silvopastural and agrosilvopastural systems in northern Mongolia.

Five years' summer school in Tunkhel, Selenge Aimag. Results and expectations

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Many studies showed that boreal and tundra plants and ecosystems may respond strongly to changes in climate, such as global warming. However, it is difficult to predict these changes due to a highly variable boreal vegetation distribution at local and regional scales in this region. Forest plants and soils store most carbon in the boreal forest ecosystems and should be closely monitored for their responses to global climate change and environmental stress.

The boreal forests cover approximately 9.1 M ha of Mongolia's territory. For the areas of the Mongolian taiga, there is so far only rudimentary information on the corresponding soil parameters and biodiversity, which both influence forest functioning. Our research site, the Tunkhel research forest, Selenge aimag, is one of the representatives of boreal forests of Mongolia.

The main goal of the summer schools in the Tunkhel research area is to grasp the "ecological value" of different forests by conducting a joint analysis of soil-ecological criteria, structural parameters of the forest, as well as indicators of biodiversity at the same site.
Since 2011, we conducted approximately 10 summer schools in Tunkhel in collaboration with the National University of Mongolia and Universities from Germany – the University of Hannover, the University of Bayreuth, and the University of Goettingen. Research areas include study of mammalian species, breeding bird

biodiversity, field zoology training, forest growth, the influence of logging on forest growth and natural regeneration, the study of soil structure and functions, and study of water quality and quantity and their effects on forest ecosystem. In addition, GIS satellite imagery measurements and ground truthing research was conducted for the area in 2017 in order to accurately predict distribution of forest types and functions in the larger scale.

Biodiversity in the Tunkhel forest included 15 species of small mammals from 6 different families, 27 species of birds, 92 species of moths, 115 species of arthopod fauna species - 56 in the forest, 57 near river and 38 species in mountain steppe. Preliminary results from summer schools show that: 1) the variability of biodiversity is possibly due to the extreme arid and hot climate, which also provided the most pronounced temperature changes between night and day, 2) human induced changes may cause the reduction of the number of tree species, in contrast, unlogged stands show an importance of nature conservation, 3) forest vegetation growth is highly dependent from soil types and pyrogenic organic matter incorporation, mycorrhization and freezing– thawing dynamics.

Findings from summer schools in Tunkhel could evidence the necessity of forest ecosystem to consider, to better understand, and to further investigate soil and water resources as the important drivers for ecosystem functioning. Furthermore, soil-ecological parameters should be carried out together with analyses of the biodiversity and site-structural parameters.

What are UNESCO biosphere reserves?

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Biosphere reserves (BR) are recognised under the scientific programme “Man and the Biosphere” (MAB) of the United Nations Education, Science and Culture Organisation (UNESCO). They conserve and protect natural capital for the benefit of the population and for the intrinsic value of nature and biological diversity. They are models for sustainable development and deliver the knowledge needed for a harmonized management of its area.

Each BR recognised by UNESCO as a site of excellence is part of the UNESCO World Net of Biosphere Reserves which in 2017 consists of 669 sites in 120 States, among them 20 transboundary ones.

BR fulfil their function by an appropriate zonation: Core areas protect the natural capital, buffer zones protect them against threatening impacts from outside and in the transition area support measures for the sustainable development of people´s

livelihood are undertaken.
Biosphere reserves are an ideal instrument to harmonize the expectations of people regarding sustainable land use. They leave room for protecting the ecologically important sites and support the wise use of the larger part of the area for the benefit of the land owners. It would be wise to accommodate the biosphere reserve concept in the national landscape planning acts and then search for the international recognition by UNESCO to give added value to the areas, for example as sites for touristic development.
The presenter will transmit the basic knowledge about the "hows" and "whys" of BR and is happy to supply more information in plenary and in bilateral conversations. A good source in English is the simple show animation prepared by German MAB Committee (https://youtu.be/rUNE0Eid-j0) explaining the concept of Biosphere Reserves.

Current situation and conservation of peatlands in Mongolia

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According to a preliminary estimation, peatlands occupy 1.7% of the total territory of Mongolia. Peatland is a very important ecosystem for Mongolia with extreme dry climate.
Peatland is a reliable source of water, maintaining soil moisture in the headwater of the rivers and soil, and being highly productive pasture and the habitat for flora and fauna. Peatland in Mongolia occurs in the foothills (piedmont), mountains, forest steppe, taiga, and high mountain tundra zones. There are abundant peat swamps in the valleys of large rivers.
Peatlands are insufficiently studied in Mongolia. The surveys took place within the framework of the Global Peatland Initiative Project (funded by the Government of The Netherlands, 2003), the Institute of Ecology and Evolution and the Institute of Forest Sciences of the Russian Academy of Science and the Institute of Botany of the Mongolian Academy of Sciences (funded within the joint Biological Complex Expeditions 2007, 2013). The modern state of peatland in Mongolia was assessed within the ADB TA project funded by Japanese Government the Strategic Planning for Peatlands in Mongolia (2015, 2016). The state of peatlands was described in 10 priority areas of Mongolia in detail.
The study shows that peatlands have been drastically degraded over the past 15

years. The major negative impacts to peatlands are global warming, overgrazing, hay harvesting, mining, forest fires, logging and road construction. These adverse impacts are relatively different in peatlands of 10 priority areas.
It becomes a part of actions for peatland conservation such as include areas with peatlands in the Convention on World Wetland conservation (Ramsar Convention, Iran, 1971) and in the category of protected areas in Mongolia, as well as to reduce the above mentioned adverse impacts.
It is no doubt that the development and implementation of "Strategic Planning for Peatlands of Mongolia" will be important for the peatland conservation of Mongolia.

Peatlands of Mongolia under changing climate and human impacts

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Some results of the peatland studies in Mongolia in relation to climate during years 2003-2016 in cooperation with Joint Complex Mongolian-Russian Biological Expedition, different Institutes of Russian and Mongolian Academies of Sciences, NGOs and other organisations are presented. Peatlands cover was estimated as 1.7% of the country's territory and plays a significant socio-economic role providing highly productive pastures (Minayeva et al., 2004, 2008). The peatlands are in critical humidity conditions and are the key objects to be affected by desertification processes (Sirin et al. 2010). Field surveys in northern and central Mongolia revealed significant diversity of mire ecosystems and several ecological mire type groups in forest and steppe zones as well as in highlands, valley and on permafrost were described. Mires provide habitats for the broad spectrum of mire species. The comparative analysis of peatlands descriptions from the 19–20th centuries and peatland relieves studied during fieldwork support the idea of dramatically changes in peatland landscapes during recent times. The paleoecological data (peat macrofossil, decomposition rate, bulk density, ash content, ^{14}C dating) demonstrates long-term changes in peatlands. In contradiction to highlands, taiga and permafrost areas were peat accumulation is an ongoing process, the peatlands of steppe and forest steppe zone, originated in the past under colder climatic conditions are degrading progressively during the last decades. In 2016, we conducted greenhouse gas (CO_2, CH_4, N_2O) flux measurements using static chamber method on different

natural and disturbed peatlands along north-south transect from Darkhat Kettle to Orkhon Valley. The data on Net Ecosystem Exchange (NEE) and Soil Respiration (R_{eco}) confirmed our assumptions about possible significant losses of carbon as a result of peatland degradation. The climate driven desertification of mires is strongly supported by over-pasturing. Wind and water erosion destroys peat soils. Wise use of peatlands could serve as a key measure for their adaptation to climate change. We thank the experts from Geological Institute RAS for assisting in ^{14}C samples dating through all years.

The pilot project on ecological restoration of peatland in Central Mongolia

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According to the outcomes of topographic maps analysis, peatlands used to cover around 1.7 % of the area of Mongolia in the middle of the last century. The latest assessment highlighted, that during the last decades, Mongolian peatlands have severely degraded both due to the climate related events and overgrazing. This causes losses of carbon stocks, increases greenhouse gas emissions and it is followed by permafrost thaw and changes in the hydrology, biodiversity, livelihoods. Most peatlands are associated with distribution of permafrost – the largest freshwater resource of Mongolia. Decrease of peatlands ecosystem diversity and permafrost degradation are directly connected. Peatlands ecosystems restoration recognised in the Strategic Plan on Peatlands of Mongolia as key activity connected to climate change mitigation and adaptation and biodiversity conservation.

With funding from the Asian Development Bank, a pilot project for peatland restoration had been launched in 2016 in Central Mongolia, Khashat sum, Tsaidam bag. The pilot aimed to merge local interests of herders with global targets on climate and biodiversity. The issues addressed: the losses of natural functions and ecosystem services of peatlands; expectations and demands of local communities and incentives for their involvement; the target ecosystem characteristics; the technical solutions; and parameters for monitoring to assess the success of the project. Restoration in subhumid conditions should avoid creation of open water surfaces: channels, reservoirs, as it leads to significant losses of water due evaporation. The methods

of ecological restoration are based on the integrative ecosystem management. The restoration concept involved fencing of springs, preventing erosion and water accumulation in soil by cascades of small dams and other small scale ecological solutions. In order to meet the needs of local herders and keep animals from springs, the dam, constructed by herders had been repaired, even if it has little value for peatland restoration. The success evaluation included both natural and social aspects.

Vegetation diversity of the peatlands in Mongolia

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The peatlands of Mongolia comprise many vegetation types. The peatland survey and research in Mongolia is underrepresented. This report summarizes the details of vegetation of peat swamps in 10 priority areas of Mongolia studied in 2015-2016. Minayeva et al. (2008) listed the highest vegetation in Mongolian peat lands, and contains 403 species in 198 genera of 62 families.

According to our study, a total of 502 species of 111 genera of plants belonging to 58 families are registered in the 10 peat swamps and these plants are highly important. *Lycopodium alpinum, Lycopodium clavatum, Juniperus pseudosabina, Juniperus sabina, Mitella nuda, Saxifraga hirculus, Drosera anglica, Drosera rotundifolia, Rhododendron dahuricum, Rhododendron parvifolium, Vaccinium myrtillus, Valeriana officinalis, Saussurea dorogostaiskii, Saussurea involucrata, Convallaria keiskei, Corrallorhiza trifida, Cypripedium calceolus, Cypripedium macranthon, Epipogium aphyllum, Neottia camtschatea, Neottianthe cucullata, Orchis fuchsii, Orchis militaris, Platanthera bifolia, Melica nutans* are occured in peat swamps and included in Mongolian Redbook. *Gentiana algida, Gentiana macrophylla, Saxifraga hirculus, Drosera rorundifolia, D.anglica, Hedysarum fruticosum, Lycopodium alpinum, L.clavatum* ховор ургамал *Valeriana officinalis, Stellaria dichotoma, Vicia geminiflora, Phragmites communis, Scorzonera parviflora, Achillea asiatica, Allium anisopodium, Artemisia santolinifolia, Astragalus mongolicus, Cacalia hastata, Ephedra sinica, Gentaina barbata, Gymnadenia conopsea, Polygonum alopecuroides, P. viviparum, Sedum aizoon* and other species grow at peat swamps and very rare and approved by Natural plants law.

A large number of vegetation surveys recorded in 2016 were made for the classification of marsh vegetation.We distinguish 29 vegetation units from the top 10 peat swamps.The predefined plants communities can be used as ecological conditions and indicators.

Depending on the intensity, we found communities like Lyme grass, Silverweed,

Lyme grass-Forbes, Silverweed-Lyme grass and etc at over used peat swamps, Needleleaf Segde, Needleleaf Segde- Lyme grass, Wormwood-Segde and etc at high used peat swamps, Wormwood-Segde and etc distributed at medium-used peat swamp, Segde-Grass, Segde-Forbes, Grass-Segde and etc at low-used peat swamp and etc distributed Chee reed grass, Grass and etc at peat swamps that are still in its natural state.

29 identified plant associations are distinctive vegetation types that cover the taiga, forest steppe, steppe meadows and sedimentary meadows. Furthermore, it is necessary to develop a more detailed classification of peat land vegetation.

Environmental Monitoring of river floodplains in Kharaa River Basin: An Integrative concept based on remote sensing and ground truthing

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Floodplains are sites of high aquatic, semi-aquatic and terrestrial diversity providing important ecosystem services (e.g. retention). However, river floodplains in Mongolia suffer from intensive livestock farming (overgrazing), soil compaction by livestock trampling and timber logging as the main causes for riverbank instability and river bank erosion. The increasing input of fine-grained sediments in the flowing water causes decrease in the benthic primary production and affects the permanent function of the hyporheic zone. Moreover, impairment of the hydraulic exchange causes a loss of habitat function and deteriorates the self-purification potential concerning nutrient retention and processing.

During the ongoing IWRM Project MOMO (funded by Federal Ministry of Education and Research of Germany, website: http://www.iwrm-momo.de), a German-Mongolian team (Leibniz Institute for Freshwater Ecology and Inland Fisheries (IGB), University of Applied Sciences (HTW) and Institute of Geography-Geoecology (IGG)) started a joint activity in 2015 to enhance existing monitoring programs in floodplains of Kharaa River Basin (KRB) with low cost remote sensing approaches by using unmanned aerial systems (UAS).

This paper describes the value chain of environmental monitoring to provide spatial information adequate to the scale of the study, satisfactory spatial and temporal resolution, and reasonable operation costs.

Detailed mappings (plant species composition, vegetation density etc.) of defined

initial training areas were assisted by high resolution images of an unmanned aerial vehicle. In a subsequent step the results of initial training areas were adapted on high resolution SAR-Images e.g. from the ESA Sentinel 1 – Mission.
To cover the huge span of phenological characteristics during different seasons and to allow the analysis of multitemporal long- and short-term changes (e.g. plant succession or habitat loss) we included also radar images of Sentinel-1A missions. The ultimate objective is to improve land use classifications of floodplains by comparing different classification algorithms.

Opportunities to integrate green economy and sustainable development aspects into policy planning, monitoring and evaluation processes in Mongolia

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'Sustainable Development' has become core strategic thinking for development agendas in the last three decades and recently the 'Green Economy' terminology has become the only tool to achieve it. Both terminologies are not well understood not only among conventional citizens, but also among scientists. Sustainable Development is well defined, but not the term Green Economy. Hence, policy makers face serious challenges to convert the vague concept of Green Economy in planning processes. The paper investigates the level of knowledge of both terminologies from policy makers and monitoring and evaluation officials of government organizations in Mongolia. I conducted a survey among 267 officials including 157 planners and 110 monitoring and evaluation officials in 2014. The result shows that the most of the planners and of the monitoring and evaluation officials regarded 'Green Economy' as a synonym of environment-friendly economy. However, two important aspects (i.e., improving human well-being and social equity) of the Green Economy were misunderstood or disregarded. Planners' understanding of Sustainable Development and Green Economy was better than that of the monitoring and evaluation officials. These results suggest that it is necessary to improve the awareness of the Green Economy and its diverse terminologies among planners and monitoring and evaluation officials.

Environmental impacts of small-scale coal mining in Nalaikh

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The project/ presentation focusses on the environmental impacts of mining (related) activities in and around Nalaikh. Samples of soil, water and air were taken and analyzed. Besides these ecological components also the socio-economic conditions are of importance for the derivation of recommendations for a better understanding and management of Nalaikh's environment (rehabilitation concept).
The aspect of rehabilitation in mining areas is becoming more and more important in Mongolian society. For the bigger mine sites in Mongolia rehabilitation concepts are available. For the smaller mine sites and especially for the Ninja-mine sites, like Nalaikh, such concepts are not available, even if the necessity is given and commonly accepted.
Nalaikh State Coal Mine opened in 1922 and was shut down in 1990. Nowadays during the peak season in winter up to 2.000 Ninja-miners work in around 200 mine shafts. Nalaikh's coal counts to about 70% of the 1 Mio. t coal burned every year in UB's ger district.
Soil analysis in the project area focuses on heavy metal contents, additional soil features are measured. In general the soil features are good, heavy metal concentrations are within the guidelines, accept for Arsenic (As). Therefore water analysis in the wells as well as in adjacent streams is mainly concentrating on As. Contamination of (ground) water with As is well known for major parts of Mongolia and also for coal-mining areas and poses a health risk to the affected people. The highest measured As-concentration in Nalaikh was > 100µg/l. Mining combined with general human activities in Nalaikh is also subject to high particulate matter (PM) pollution in the air. The main sources for as well as the composition of the pollutants are determined. During the winter the average PM 2.5 concentration is 200 µg/m³.

Land use classification of river floodplains in Kharaa River Basinbased on ESA Copernicus mission data

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Floodplain ecosystems in Kharaa river basin suffer from grazing pressure, pasture digression and subsequent erosion at river banks. On the one hand environmental

monitoring like survey of plant communities and above-ground phytomass requires detailed mappings on a grid scale of 1 to 100 square metres on-site. On the other hand observation time and plot size are limiting factors. Data of remote sensed areas is lower detailed but can be quickly collected in a large scale. Our objective is to combine the benefits of both methods. Therefore detailed mapping plots assisted by high resolution images of unmanned aerial systems (UAS) represent initial training areas which where adapted on high resolution SAR-Images e.g. from the ESA Sentinel 1 – Mission. Higher reliability can be achieved by multi-temporal SAR-images which can capture phenological characteristics of different plant communities. Long- and short-term changes like succession or habitat loss can be recorded and analysed directly.

River meadows of Kharaa-River-Basin were analysed and interpreted using multi-temporal radar images of Sentinel-1A. Ground truth and training data where used from UAS imagery and field mappings. Different classification algorithms where applied and compared. Random Forest Classification yielded the most reliable results. Despite a high scatter of the class confidences, the visual verification with ground truth data led to a convincing overall result which gives an understanding about the application of multi-temporal radar images. The poster presents initial results of a planned long-term environmental monitoring in Kharaa River Basin.

The clue to the origin of rice species and sub-species held by Boro rice (*Oryza sativa* L.) from Uttar Pradesh, India

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Boro rice (Oryza sativa L.) is unique primitive rice grown in eastern part of Uttar Pradesh (U. P.), India during winter months. Geographically it was grown between Bahraich district in the west to Balia district in Pradesh (U. P.0 of India, and southern border of Nepal in the north to Mirzapur district in the south of Uttar Pradesh in India. It differs from other boro rices grown in Bangladesh, and even in Assam, West Bengal and Bihar states in India as its faces extremely lower temperature of 3^{o}C during its germination and vegetative stage. During the reproductive stages, boro faces as high as 46^{0}C. Crosses of boro rice with common *Oryza sativa* L. gives high to complete sterility. Boro rice from U. P. has sterile cytoplasm and even cytoplasmic-genetic male sterile lines were developed. It has unique nutritional value. PRDF collected 570 accessions of Boro rice and after describing for 42 morph-agronomic characters, its catalogue and collection was deposited in the National Gene Bank at the National Bureau of Plant Genetic Resources (NBPGR), New Delhi. There are unique morpho-agronomic characters in boro, which provide a link between *indica* and *japonica* sub-species of *Oryza sativa* L. Detail studies with

modern biotechnological tools (isozyme and DNA markers) are needed to establish its distinctness from other groups and establish the link between the two sub-species of *Oryza vis a vis* other wild species native to this region.

POSTERS

Carbon pool densities and a first estimate of the total carbon pool in the Mongolian forest-steppe

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The boreal forest biome represents one of the most important terrestrial carbon stores, which gave reason to intensive research on carbon stock densities. However, such an analysis does not yet exist for the southernmost Eurosiberian boreal forests in Inner Asia. Most of this forest is located in the Mongolian forest-steppe, which is largely dominated by *Larix sibirica*. We quantified the carbon stock density and total carbon pool of Mongolia's boreal forests and adjacent grasslands and draw conclusions on possible future change. Mean aboveground carbon stock density in the interior of *L. sibirica* forests was 66 Mg C ha^{-1}, which is in the upper range of values reported from boreal forests and probably due to the comparably long growing season. The density of soil organic carbon (SOC, 108 Mg C ha^{-1}) and total belowground carbon density (149 Mg C ha^{-1}) is at the lower end of the range known from boreal forests, which might be the result of higher soil temperatures and a thinner permafrost layer than in the central and northern boreal forest belt. Land use effects are especially relevant at forest edges, where mean carbon stock density was 188 Mg C ha^{-1}, com-

pared to 215 Mg C ha^{-1} in the forest interior. Carbon stock density in grasslands was 144 Mg C ha^{-1}. Analysis of satellite imagery of the highly fragmented forest area in the forest-steppe zone showed that Mongolia's total boreal forest area is currently 73,818 km^2 and 22 % of this area refers to forest edges (defined as the first 30 m from the edge). The total forest carbon pool of Mongolia was estimated at c. 1.5−1.7 Pg C, a value which is likely to decrease in future with increasing deforestation and fire frequency, and global warming.

Higher climate warming sensitivity of Siberian larch in small than large forest islands in the fragmented Mongolian forest steppe

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Forest fragmentation has been found to affect biodiversity and ecosystem functioning in multiple ways. We asked whether forest size and isolation in fragmented woodlands influences the climate warming sensitivity of tree growth in the southern boreal forest of the Mongolian *Larix sibirica* forest-steppe, a naturally fragmented woodland embedded in grassland, which is highly affect by warming, drought and increasing anthropogenic forest destruction in recent time. We examined the influence of stand size and stand isolation on the growth performance of larch in forests of four different size classes located in a woodland-dominated forest-steppe area and small forest patches in a grassland-dominated area. We found increasing climate sensitivity and decreasing first-order autocorrelation of annual stemwood increment with decreasing stand size. Stemwood increment increased with previous year's June and August precipitation in the three smallest forest size classes, but not in the largest forests. In the grassland-dominated area, the tree growth dependence

on summer rainfall was highest. Missing ring frequency has strongly increased since the 1970s in small, but not in large forests. In the grassland-dominated area, the increase was much greater than in the forest-dominated landscape. Forest regeneration decreased with decreasing stand size and was scarce or absent in the smallest forests. Our results suggest that the larch trees in small and isolated forest patches are far more susceptible to climate warming than large in continuous forests pointing to a grim future for the forests in this strongly warming region of the boreal forest that is also under high land use pressure.

The Alien (Invasive) Plant species of the vascular flora of Mongolia

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The present checklist is based on the "*New conspectus of the vascular plants of Mongolia*" (Urgamal et al. 2014) and was compiled using the Database of the Mongolian Flora (Urgamal 2008-2017) as the basis for this checklist. The Herbarium (UBA) at the Department of Botany, Institute of General and Experimental Biology, Mongolian Academy of Sciences and Herbarium (UBU) at the Department of Biology of the National University of Mongolia were checked for new findings and the material was partly critically revised.

The about floristic findings of checklist of alien plant species to the vascular flora of Mongolia, which was on the species level have been made by new book of the "*Conspectus of the vascular plants of Mongolia*".

At present, total of 51 species are alien species (1.6%) belonging to 48 genera and 23 families to Mongolia. The families and genera richest in alien species are *Poaceae* (8 species), *Fabaceae* (7 species), *Asteraceae* (6 species) families and *Ornithopus* (2 species), *Sorghum* (2 species), and *Rumex* (2 species) genera.

The article reports on the new records of 16 alien species (*Agrostis gigantea* Roth, *Asparagus officinalis* L., *Butomus umbellatus* L., *Camelina sativa* (L.) Crantz, *Celastrus orbiculatus* Thunb., *Clematis terniflora* DC., *Elaeagnus angustifolia* L., *Hypericum perforatum* L., *Lotus corniculatus* L., *Lythrum salicaria* L., *Nymphoides peltata* (S.G.Gmel.) Kuntze, *Phalaris arundinacea* L., *Poa pratensis* L., *Rumex crispus* L., *Tamarix ramosissima* Ledeb., *Typha latifolia* L.) in the Mongolia since the publication of the conspectus.

The alien plants includes to 1 species (*Elaeagnus angustifolia*) as "very rare", 2 species (*Hypericum perforatum, Melilotus albus*) as "rare", and 2 species (*Tamarix ramosissima, Elaeagnus angustifolia*) as "relict", and 1 species (*Elaeagnus angustifolia*) as "Red Book" of Mongolia.

One alien species (*Elaeagnus angustifolia*) is listed as "Critically Endangered (CR)" in the Mongolian Red List Book for the vascular flora of Mongolia.
The areas in the north (Mongol Dauria, Khentii, Khangai) of Mongolia show the highest richness of known alien vascular plant species with up to 15 to up species per region. The lowest species numbers are found in western (Khovd) and eastern Mongolia (Foothills of Great Khingan, East Mongolia) with 0 to 5 species of alien (invasive) plants per region (Urgamal et al. 2014). Most sub-endemic species occur in Mongol Dauria (23 species), the Khangai Mountains (16 species), and the Khentii Mountains (15 species).

Mongolian racerunners (*Eremias argus*) occupancy in Siberian marmots (*Marmota sibirica*) marmot active and none active sites

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Habitat fragmentation caused by anthropogenic activities alters the distribution, abundance and diversity of wildlife species worldwide. One of example is Siberian marmots have experienced a >75% decline across Mongolia since the 1990s. Burrowing mammals are keystone, ecosystem engineers in many communities because burrowing is an engineering activity that can directly and indirectly alter the availability of resources, have effects at multiple spatial and temporal scales, and have a significant role in community organization. The deep and complex burrow systems of marmots, provide underground shelters with stable microclimates that other vertebrate and invertebrate animals exploit. Our general hypothesis was that marmot colonies positively influence racerunner occupancy probability because burrows offer shelter from environmental conditions, refuges for predation, and a high diversity and number of insects and other prey items. Our result showed that occupancy model selection results indicated-racerunner occupancy is influenced by the presence of a Siberian marmot colony: Marmot active colony + inactive colony- ψ(AMC+IMC), p(temp+temp^2) was the best approximating model. Racerunner detection was highest at approximately 24.3 °C. For the aspect and elevation model, foothill was an important influence on lizard occupancy. Our results show that these marmot burrow had greatly influence Mongolian racerunner occurrence and suggest

that habitat modification by rodent ecosystem engineering play ecological influence on biodiversity.

Cave-Dwelling Bats Research in Mongolia: Conservation status, Threats & Needs

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Bats are one of the least studied and less well-known mammals in Mongolia. There are 20 species of bats distributes in Mongolia (six of which are known to hibernate here). Almost half of them categorized as Data Deficient by IUCN. Large number of individuals and species concerned, conservation of "swarming sites" is vitally important. Clearly swarming sites merit special consideration in conservation management strategies for cave-dwelling bats. Yet, there is lack of data on cave-dwelling bats in Mongolia. Truly, cave animals especially bats are unstudied in Mongolia. Cave-dwelling bats survey was conducted between April 2016 to April 2017 at Tsagaan del, Shar khanan, Suugt, Khuit and Dayandeerkh caves in southern, north and northwestern Mongolia. We identified 6 species of bats hibernate in 5 different caves in Mongolia. Result shows north and northwestern caves which are Dayandeerkh and Suugt caves bat species richness similarity was 67% and between Khuit and Suugt caves was 40%. Brown long-eared bat (*Plecotus ognevi*) was dominant species in the study sites. This species registered at 3 caves which are located in the north and northwestern areas. All hibernating bat species was categorized as Least Concern by IUCN at regional level, except Brandt's bat (*Myotis gracilis*). Dominant threats on cave bats is little known but eco-tourism, mineral water and removal of crystals may affect threats in the near future. Hibernation is key to survival for many bats in temperate regions and understanding use of hibernacula is important. Research collaboration and awareness activities needed on cave bats in Mongolia.

Small scale variation of precipitation and temperature along elevation gradients and their importance for hydrological modelling

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Actual evapotranspiration (AET) represents a key ecosystem variable especially in arid and semi-arid regions and depends on the variation of climatic variables such as temperature, precipitation and radiation. The patterns of precipitation and temperature are probably most cited-factors for the distribution of plant and species richness and vary along altitude. The present study targets to assess AET in the Sugnugur valley in northern Mongolia using the TRAIN hydrological model based on the observations of two consecutive summer field campaigns. We also study the spatial and temporal variability of the precipitation gradient (PG) and temperature lapse rate (LR) based on daily observational data from 9 meteorological stations over the Khentii Mountains using linear regression analysis. As hypothesized, seasonal patterns of precipitation and temperature were observed in monthly gradient variations with higher PG and LR during summer. The mean summer LR was considerably greater than the commonly used environmental LR. Despite the distinct daily average temperature along altitude, the diurnal LR shallows in the summer mornings (2 hours after sunrise) and after sunset. The results also reveal that there is a great variability in summer precipitation over short horizontal distances. South-western part of the mountains is wetter during summer due to probably prevailing wind direction and orographic effect, and it may have a stronger PG than the southern part. A uniform PG cannot be established, and longer-term data associated with different topographic influences may explain our findings. We complete our analysis by showing the variability of AET during the growing season and it provides valuable information to the spatial distribution water balance elements as well as plant and species richness in the Khentii Mountains.

Contribution to the mammalian fauna of the National Park Tavan Bogd, Western Mongolia

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The Mongolian-German Biological Expedition team was worked in 2014 from 31.07 until 05.08. in the west Mongolian National Park Tavan Bogd near the lakes Choton-

nuur and Dajan-nuur. Within this, very short time were recorded the Insectivora, *Sorex caecutiens* and *Sorex tundrensis*. In addition, the Chiroptera, *Plecotus ognevi* and *Myotis petax* were collected. A nursery roost of *Myotis petax* in a tree cave (*Larix sibirica*) was analysed. From the genus *Clethrionomys* the species *C. rutilus* and *C. rufocanus* were caught. Two *Microtus* species, *M. gregalis* and *M. oeconomus* were collected. The reproductive state of all caught animals was determined. From the family Cricetidae was *Phodopus campbelli* found only. Beside these small mammals the Sciuridae species *Eutamias sibiricus*, *Spermophilus undulatus* and *Marmota baibacina* were documented photographically.

Contribution to the mammalian fauna of Eastern Mongolia

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Between 2008 and 2014, four Mongolian-German Biological Expeditions worked for short periods in Eastern Mongolia. The results related to mammalian fauna were summarized. Investigation areas were parts of the Daurian steppe, Buir-nuur and Nömrög-gol regions. Chiroptera were recorded with four species. Especially, *Vespertilio sinensis* has to be considered as a characteristic species of the eastern steppes. Aggregations of some thousand individuals were found in the Buir-nuur region. The other three species were *Plecotus ognevi*, *Myotis petax* and *Myotis aurascens.* It is to expect, that in eastern Mongolia some more Chiroptera-species will recovered in future.

The degree of investigation of insectivores is also insufficient. We recovered *Mesechinus dauuricus*, *Sorex tundrensis* and *Sorex caecutiens* as well as *Crocidura shantungensis*. From the family Sciuridae we collected only *Spermophilus dauricus* and *Tamias sibiricus*. The Muridae are represented by *Rattus norvegicus*, *Mus musculus*, and *Apodemus agrarius* et *peninsulae*. From these species exist representative sample series. In literature is documented, that East Mongolia belongs to the autochthonic centre of *Rattus norvegicus.* In the 30 and 40ties of the last century Manchuria and East Mongolia were occupied by Japanese military which used *Rattus norvegicus* and its ectoparasites as biological weapons to transfer plague, anthrax and other pathogenic agents to humans. It would be useful to study the DNA of the recent wild *Rattus norvegicus* to reveal their genetically origin.

The Spalacidae are represented by *Myospalax psilurus* and *M. aspalax* without any new investigation result of our expeditions. *Microtus fortis* and *Microtus gregalis* are the only recorded species of the Arvicolidae as well as *Cricetulus barabensis* and

Phodopus campbelli for the Cricetidae. Morphometric data, remarks on reproduction state and habitat structures and requirements are subsumed here.
In Eastern Mongolia, we can expect many further mammalian species, which are to recover. Stationary research is recommendable, concentrated on small mammalian communities, reproduction cycles of different species and their feeding ecology. The Study of the economic importance and relevance as well as the effectiveness of the great new agro-ecosystems in eastern Mongolia and the consequences of the change from natural into culture steppes is - and must be - a great challenge for the Mongolian sciences and scientists.

Rarely found bat species in Mongolia

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Nineteen different bat species of 7 different genera, including rare and potentially first-record species presented in this study, have been currently reported for Mongolia. While recent genetic and morphological investigations reveal strong evidences of at least 2 (3) novel or cryptic species and subspecies (Dolch et al., in prep.), the Mongolian bat fauna comprises 7 species of the genus *Myotis*, 4 of the genus *Plecotus*, 3 of the genus *Eptesicus*, 2 of the genus *Vespertilio* and 1 for each of the genera *Hypsugo*, *Nyctalus* and *Murina*. Despite increasing research towards Mongolian bats in the past decades, approximately 50% of the currently known species are just found rarely or very rarely and thereby limiting insights into their distribution, ecology, threats and thus conservation.
Here we present a brief overview of rarely found bat species in Mongolia captured during various Mongolian-German Biological Field Expeditions since 1962. With exception of the genus *Plecotus* that is covered in a separate study (Dolch et al., in prep.), we will give a short summary and first as well as novel insights into the ecology and distribution of those rare species comprising (a) the first records of *Myotis blythii* (2011), *Myotis bombinus* (2008) by Dolch and colleagues and *Nyctalus noctula* (1974, 1985) by Stubbe and Stubbe for Mongolia as well as (b) 're-discovered' and rare Mongolian species such as *Eptesicus (serotinus) turcomanus*, *Murina hilgendorfi* and *Myotis frater*.

Prevalence and diversity of blood parasites of raptors in Mongolia

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Different species of malaria and related blood parasites are commonly infecting not only humans and other mammals, but also many bird species. These infections can constitute substantial threat to the health of local populations. Modern molecular techniques allow the identification of molecular lineages and species of these parasites from blood samples. Nonetheless, for most blood parasite species information on both health consequences and local prevalence is missing. Birds of prey constitute a particularly interesting case, because they get infected mostly in the nestling phase, while immobile and featherless. This makes raptor nestlings to a good indicator of the local transmission conditions and of the avian malaria prevalence or lineages which are present in Mongolia. We analyzed and will present results of the discovered diversity. For one raptor host – Black kite, *Milvus migrans* – we compare the prevalence and diversity of the Mongolian population with the same indices in a German and a Spanish population, and make conclusions about the local conditions for transmission of avian blood parasites.

The power of DNA barcoding for species delimitation of the genus Sphingonotus (Orthoptera, Oedipodinae)

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With about 170 currently known species, *Sphingonotus* (Fieber, 1852) represents one of the most diverse genera within the Oedipodinae. The genus is worldwide distributed, preferring mountainous, desert and semi-desert habitats with sparse vegetation. However, the taxonomic status of many species groups within the genus is unclear and recent molecular studies have further complicated the relationships within the genus. Therefore, combined approaches of classical and modern morphological methods and molecular techniques are required to clarify the status of difficult taxa. Hebert et al. 2003 discovered that a short region (658 bp) of the Cytochrome Oxidase I (COI) gene would be an innovative tool to rapidly and cheaply determine the identity of an Organism. The chosen gene region of COI has the characteristics to potentially be species specific for a large fraction of known and unidentified diversity. It is characterized by a large genetic distance between

species (barcode gap), but low genetic variation between individuals within one species. Despite that it is nowadays possible to just combine generated sequences of an individual with the round 5,000,000 online available barcodes (Sherry et al. 2001; Ratnasingham & Hebert 2007). Although these barcodes have a high standard, nuclear – mitochondrial pseudogenes (numts), hybridization and incomplete lineage sorting (ILS) still pose serious problems and may lead to false identification (Funk et al. 2003). Here, I use DNA barcoding in combination with morphology to test the power of DNA barcoding in the taxonomically difficult group *Sphingonotus*. I focus on the Mongolian species, as Central Asia is one of the hotspots of species diversity of the genus. Therefore, four different statistical delimitation methods were tested, to find out, if any method agrees with the morphological assignment of species. Summing up the results for the dataset showed a high variance across methods. Several reasons may contribute to this varying success; those reasons are discussed in this study in detail.

Activity of enzymes involved in nitrogen and phosphorus circulation in cropland soil

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Soil fertility largely depends on the activity of biological processes in the soil in which soil enzymes actively participate. Studies on enzyme activities provide information on the biochemical processes occurring in soil. There is growing evidence that soil biological parameters may be potential and sensitive indicators of soil ecological stress or restoration (Kizilkaya & Bayrakli, 2005) and management – induced changes in soil quality (Kennedy & Papendick, 1995). In our country, the crop rotation occurs as wheat-rape-wheat-rape which leads to loss of soil fertility and yield reduction. The area of rapeseeds increases every year. That is why in this study we conducted comparative studies between natural and cropland soil enzymes involved in nitrogen and phosphorus circulation. Soil samples were taken in 2015 and 2016 from the Jargalant farm wheat, rape fields and fields beside them, where these crops do not grow. Natural soil was taken as control. Soil samples were taken from the 0-25 cm of the soil surface. For estimation of titrative acidity soil samples were shaken with 0.9% NaCl for 30 minutes after what was filtered and titrated by 0.001 N NaOH, available phosphorous - by colorimetric assay with hydroquinone, which based on the bicarbonate method developed by Olsen *et al*. in 1954. After adding 2 ml of Na_2CO_3 and Na_2SO_3 into soil filtrate mixture of 1% hydroquinone was added and the absorbance was measured at 750 nm (Jones, 2001). Calculations were

made according the phosphate (0.05 mg/ml) calibration curve. Amount of available phosphorous was expressed in μg/g of soil sample. Protease activity (EC 3.4.) by Kunitz M. method (Kochetov, 1980), urease (EC EC 3.5.1.5) by I.N.Romeiko and S.M.Malinskaya colorimetric assay (Khaziev, 2005), activity of acid (EC 3.1.3.2) and alkaline phosphatases (EC 3.1.3.1) were estimated by Tabatabai-Bremner assay with para-nitrophenylphosphate (PNPP) as a substrate (Khaziev, 2005). Enzymatic activities were expressed in units (U): 1U of phosphatases activity were defined as the amount of enzyme protein in 1 g of soil which forms 1 mg of para-nitrophenol in 1 hour, 1U of protease activity was taken as 1μg of tyrosine formed in 1g of soil in 1 hour, 1U of urease activity was taken as 1 μg nitrogen formed from NH_3 by urease of 1g soil in 1 hour. All experiments were carried out with a 3-5 repetition and mean values were taken. Results show that average titrative acidity in all soil samples increased, whereas available phosphorous decrease substantially in cropland soils. Activity of acid and alkaline phosphatases during this period decreased in all soil samples. Protease activity increased and the activity of urease decreased. In cropland soils these changes were observed significantly compared to the control soil. From these results we can see that crop cultivation influences on intensity of biochemical processes which are important in soil functioning, such as nutrient mineralization and cycling, decomposition and formation of soil organic matter, so we have to take it under consideration when accessing soil erosion and changes in soil fertility and study soil-plant relationships.

No predation of livestock – feeding ecology of the wolf (*Canis lupus*) in a near-natural ecosystem in Mongolia

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Due to an ongoing decline of wildlife populations and an increased number of livestock, it may be assumed that wolf predation on livestock in Mongolia has reached a high level. However, information on the feeding ecology of wolves in Mongolia is rare. In particular there is no knowledge on the feeding habits of the wolves in mountain taiga and mountain forest steppe regions in the northern parts of Mongolia, which have relatively high wildlife diversity and are sparsely populated by humans.

To face this question, 137 wolf scats were collected from Khonin Nuga in the Khentei mountain range in northern Mongolia between 2008 and 2012. In this buffer zone of the "Strictly Protected Area of Khan Khentii", the Mongolian-Daurian mountain forest steppe borders the Siberian mountain taiga. There is a relatively large number

of wild ungulates but, the research station aside, next to no human habitation.
The food remains of the scats were determined mostly by microscopic identification of hair, but also by bone fragments, teeth, hoofs or feathers. The analysis of scats was performed according to frequency of occurrence and consumed biomass, and prey selectivity was calculated.
Almost all faeces contained remains of wild ungulates, which made up 89 % of the biomass consumed. Siberian roe deer (*Capreolus pygargus*) was the most important and only positively selected prey species. It was followed by red deer (*Cervus elaphus*) and wild boar (*Sus scrofa*), which were both negatively selected by wolves. Consumption frequency and biomass underlay minor seasonal fluctuations. Wolves also feed on buffer prey species such as lagomorphs and small mammals and secondary diet components such as medium-sized mammals, birds, reptiles, fishes, insects, and fruits are infrequently consumed. No evidence of domestic ungulates was found in the wolf diet. Near-natural habitats with a diverse fauna of wild animals should not lead to any loss of livestock.

Communities of early emerging insects of the forest steppe in Western Khentii

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The insect diversity varies depending on seasonal changes and temperature fluctuations. Therefore, resistance of insects in low temperatures is interesting issue, and we studied early insects, which develop and growth in spring season. Study materials were collected using fit-fall traps in late April and early May in the western Khentii mountain region. We studied the communities of early emerging insects in the forest-steppe ecosystem in northern Mongolia, and found 124 species belonging to 89 genera, 49 families and 8 orders. The explored insects are grouped into two main ecoligical groups, such as surface-active insects and soil-inhabitants, among which a few groups, such as Coleoptera 52%, Lepidoptera 17%, Diptera 10%, Hymenoptera 10% are predominated with highest occurences of species. In terms of species richness, Coleoptera with 75 species or 60% are dominated, and then other groups, Lepidoptera with 20 spp. or 16%, Hymenoptera 12 spp. or 10%, Diptera 8 spp. or 6%, Hemiptera 4 spp. or 3%, Orthoptera 3 spp. or 3%, Homoptera, Dermaptera 1 spp. or 1% each, are found. The insect species diversity in the most study habitats was relatively poor and uneven. Distribution of species among the main habitats, the forest-edge ecotone has largest number of species 81 spp., followed by river meadow 71 spp., the forest-interior have lowest species richness 47 spp., whereas number of individuals were relative high in the river meadow,

which contained more than 1100 individuals per square meter, the forest-edge – 787, the forest-interior 695 individuals. Communities of insect in this region contained relatively few species with high abundance, but most other species represented with low density. Therefore, the dominance indexes of species shows large number of resident and subresident species, but very few dominant or subdominant species.

First report of the herb field mouse, *Apodemus uralensis* (Pallas, 1811) from Mongolia

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Before the current work, only two species of the genus *Apodemus* (*A. peninsulae*, *A. agrarius*) were known from Mongolia. The only species distributed over large parts of Mongolia was the Korean field mouse *Apodemus peninsulae*. Therefore, it was completely unexpected that between 2011 and 2013 American-Mongolian, Russian-Mongolian and German-Mongolian mammalogical expeditions independently collected specimens from the southwestern edge of Mongolia that were identified as the herb field mouse *Apodemus uralensis* (Pallas, 1811). In addition, we discovered several additional records of this species in different scientific collections from as early as 1976.

Individuals of *Apodemus uralensis* were obtained from seven localities in Mongolia, all restricted to the southwestern part of the Mongolian Altai Mountains and the adjacent Mongolian part of the Dzungarian Gobi Desert. These field-records appear to represent the easternmost border of the Eurasian distribution area of this species. In the Dzungarian Gobi and the Mongolian Altai, the herb field mouse occurs in river oases in the foothills (1,147 m) up to mountainous regions as high as 2,468 m. Suitable habitats include riparian zones of the river valleys with dense stands of willow and poplar. It has also been captured in riparian larch forests in the Mongolian Altai.

The body and skull measurements of *Apodemus uralensis* from Mongolia are slightly

larger than from Europe, Asia Minor and Siberia, but the adjacent population in north-western China corresponds well with the Mongolian herb field mice. Molecular genetic analysis of eleven specimens from our collections confirms the species diagnosis of *Apodemus uralensis*, with the sequence being identical to GenBank sequences of individuals from eastern Kazakhstan and northwestern China showing low genetic differences between geographic regions. On the other hand we can very well distinguish two lineages of *Apodemus uralensis* from Asia and from Europe. Our analysis indicates that the mice we studied from southwestern Mongolia belong to the subspecies *A. uralensis kastschenkoi* (Kuznetzov, 1932). In future this should be clarified by collecting more material of the species in question and conducting further morphological as well as molecular genetic investigations.

Restoration of the historical bird collection of the Bogd Khaan Palace Museum in Ulaanbaatar

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The project: "Restoration of the historical bird collection of the Bogd Khaan Palace Museum in Ulaanbaatar" in 2016/2017 was a cooperation of the Bogd Khaan Palace Museum and the Senckenberg Museum of Natural History Görlitz, including the National University of Mongolia and the Mongolian Museum of Natural History. The project was financially supported by the Mongolian Ministry of Education, Culture, Science and Sports.

The bird collection of the Bogd Khaan Palace Museum currently contains 74 mounted birds, most of them over 100 years old. Around 1900 the Bogd Gegen, at that time the spiritual leader of Buddhism in Outer Mongolia and later the king of independent Mongolia, purchased these birds and other zoological objects from the German company J.F.G.Umlauff in Hamburg.

The restoration of this historical bird collection was realised during two restoration courses, each lasting two weeks. Two German taxidermists from the Senckenberg Museum of Natural History Görlitz taught colleagues from Mongolian museums and institutions several methods for the restoration of mounted birds. After the courses the trained colleagues finished the work on the bird collection.

Restoration for each mounted bird was planned individually. The first step was recording available data and the condition of the object. Then the feathers were

cleaned and brittle feathers were refattened. Damage to beaks, legs and on the pedestals had to be repaired. Unstable or separated heads, wings, tails, toes or feathers had to be fixed. Several birds had lost their original position which had to be corrected. Missing toes, beaks, eyes and tails were replaced with artificial materials. Finally beaks, legs, toes and replaced parts were coloured. All restoration steps and the final condition of the object were documented.
The mounted birds were identified, mostly to species level. The entire exhibition of the bird collection in the Bogd Khaan Palace Museum will be renewed and a printed catalogue with photos and written information will be published.

First records of the invasive Amur sleeper (Perccottus glennii Dybowski, 1877) in Selenge river basin of Mongolia

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The Amur sleeper (*Perccottus glenii* Dybowski, 1877, family Odontobutidae) is native to the Far East of Russia. The main part of its native range is restricted of the Amur river basin. In recent years, Amur sleeper has been one of the most invasive fish species in Europe. It has been reported in the water-bodies of many countries and its range in Europe is continually increasing. The problem of this species movement and spread to new areas is important in terms of the phenomenon of invasiveness.
Invasive species are one of the leading threats to native wildlife. They can harm the environment, the economy or even, human health.
Amur sleeper live in Amur drainage of Mongolia. It has been recorded in the Khalkh river. That regional distribution covers less than 1% of the area of Mongolia. However, we recorded this species from down stream of Selenge river in the Arctic basin during the expeditions of spring, summer and fall of 2016. Maurica Kottelat wrote Amur sleeper was recorded from the Selenge river of Russia, soon that will come to Mongolia.

Notes on a collection of fishes from Mongolia (Results of the Mongolian-German Biological Expeditions since 1962)

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The material of Mongolian fishes collected during the Mongolian-German Biological Expeditions in the spring, summer and autumn of 1985, 1988, 1990 and 2002 from localities belonging to the three major drainage systems: the Arctic (I-II), Pacific and Central Asian Internal basins. This collection is represented more than 390 specimens of 29 species belonging to 22 genera and 10 families.

We proposed two goals. The first was to conduct the faunistic research in Bulgan-gol (Arctic II) and Onon-gol basins, together with compiling data on diversity, frequency, zoogeography and protection of rare and vulnerable species, such as *Gymnocephalus cernuus* [Linnaeus, 1758], endemic and rare species, *Nemacheilus strauchi* [Kessler, 1874], *Oreoleuciscus humilis* [Warpachowski, 1889] and endangered species, *Tinca tinca* [Linnaeus, 1758]. The second goal was to study the life history, biology of reproduction, host-food interrelations and economic importance of those fishes.

Bulgan River in South-western Mongolia, which flows from the southern slope of the Altai in the Dzungaria present a special case. In this river we found seven fish species: *Leuciscus dzungaricus* n.sp., *Leuciscus leuciscus baicalensis, Carassius auratus gibelio, Perca fluviatilis, Gobio gobio cynocephalus, Tinca tinca* and *Nemacheilus barbatula toni*. The presence of Sibirian species among the aquatic fauna of the Bulgan River demonstrates its separation from the Arctic basin during the uplift of the Mongolian Altai.

The fish fauna of the Central Asian Internal Basin of Mongolia consists of small number of rare and endemic species, dominated by the indigenous polymorphic genera *Oreoleuciscus* (O. *pewzowi, O.potanini* and *O.humilis*) and *Thymallus brevirostris*.

The Pacific Basin represents 13.5% of the total area of Mongolia and 15.9% of the country's aquatic resources. They include the rivers Onon, Ulz, Kherulen and Khalkhyn-gol. Most of fish fauna are Cyprinidae and *Parasilurus asotus*.

Environmental Monitoring of river floodplains in Kharaa River Basin: An Integrative concept based on remote sensing and ground truthing

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Floodplains are sites of high aquatic, semi-aquatic and terrestrial diversity providing important ecosystem services (e.g. retention). However, river floodplains in Mongolia suffer from intensive livestock farming (overgrazing), soil compaction by livestock trampling and timber logging as the main causes for riverbank instability and river bank erosion. The increasing input of fine-grained sediments in the flowing water causes decrease in the benthic primary production and affects the permanent function of the hyporheic zone. Moreover, impairment of the hydraulic exchange causes a loss of habitat function and deteriorates the self-purification potential concerning nutrient retention and processing.

During the ongoing IWRM Project MOMO (funded by Federal Ministry of Education and Research of Germany, website: http://www.iwrm-momo.de), a German-Mongolian team (Leibniz Institute for Freshwater Ecology and Inland Fisheries (IGB), University of Applied Sciences (HTW) and Institute of Geography-Geoecology (IGG)) started a joint activity in 2015 to enhance existing monitoring programs in floodplains of Kharaa River Basin (KRB) with low cost remote sensing approaches by using unmanned aerial systems (UAS).

This paper describes the value chain of environmental monitoring to provide spatial information adequate to the scale of the study, satisfactory spatial and temporal resolution, and reasonable operation costs.

Detailed mappings (plant species composition, vegetation density etc.) of defined initial training areas were assisted by high resolution images of an unmanned aerial vehicle. In a subsequent step the results of initial training areas were adapted on high resolution SAR-Images e.g. from the ESA Sentinel 1 – Mission.

To cover the huge span of phenological characteristics during different seasons and to allow the analysis of multitemporal long- and short-term changes (e.g. plant succession or habitat loss) we included also radar images of Sentinel-1A missions. The ultimate objective is to improve land use classifications of floodplains by comparing different classification algorithms.

Suggestion for registering Sand lizard (*Lacerta agilis* Linnaeus, 1758) in the Mongolian Red Book

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The third edition of the Mongolian Red Book has been published including rare plants and animals. There were included two species of amphibians (Siberian salamander, *Salamandrella keyserlingii* Dybowski, 1870: Asiatic grass frog, *Rana chensinensis* David, 1875) and 4 species of reptiles (Gobi naked-toed gecko, *Cyrtopodion elongates* (Blanford, 1875), Steppe runner, *Eremias arguta* Pallas, 1773, Tatary sand boa,*Eryx tataricus* (Lichtenstein, 1823), Slender Racer, *Coluber spinalis* (Peters, 1866)) registered in the first edition of Red book in 1987. Another three species of amphibians and reptiles (Pewzow's toad, *Bufotes pewzowi* (Bedriaga, 1898), Japanese tree frog, *Dryophytes japonicas* (Guenther, 1859), Sunwatcher,- *Phrynocephalus helioscopus* (Pallas, 1771)) has been added into the second edition of Red book list in 1997. And one species of snake (Northern viper, *Pelias berus* (Linnaeus, 1758)) is added in the third edition of Red Book in 2013.

Sand lizard is first reported by Terbish and Munkhbayar (1988) from Bulgan soum of Khovd aimag. However, it is widely distributed around the world, but its only population margin reached to Mongolia as a small area in southern part of Altai Mountains. In July 2016, we reported this species from Bayanmod and Ikhertoli of Bulgan soum. According to previous study, this species occupied with juniper plants, and this time we captured it from nettle and straw grasses. This species is big in size, from head to the tip of tail is about 25 cm. Females are brownish, males are green, and during the reproduction season they became more colorful. We recommend that Mongolian rare and interesting sand lizard should be included in the Mongolian Red Book as addition to the third edition, without waiting for publication of the fourth edition. Also some populations of this species near the state border should be acclimatized in suitable habitats of eastern part of Bulgan River.

New records of the genus *Potentilla* L. (Rosaceae) and changes to the conspectus of the vascular plants of Mongolia

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We added new records of three species (*Potentilla asiatica*, *P. burjatica, P. smirnovii*) to the flora of Mongolia. Since the publication of the last conspectus

(Gundegmaa, 2014), there are two papers that were published with 5 species (*Potentilla elengantissima*, *P. nervosa*, *P. martjanovii*, *P*. *olchonensis*, *P. tericholica*) which are also new records to the vascular plants of Mongolia. We suggest new combinations on variations of 5 species of *Potentilla* L. The revision of this genus suggest that these three species (*Potentilla acervata*, *P. semiglabra*, *P. gelida* subsp. *boreoasiatica*) Gubanov (1996) should be added back to the flora of Mongolia. Following six species (*Potentilla altaica*, *P. approximata*, *P. arenosa*, *P. ornithopoda*, *P. crebredens*, *P. supina* susp. paradoxa) were reported as subspecies and synonym in the conspectus (Gundegmaa, 2014) and these six species should be changed to species for the flora of Mongolia.

We report a new synonym which is *Potentilla junatovii* Rudaya, 2002 which is a synonym of *P. subditata* Yü et Li, 1980.

Three species (*Potentilla ewersmanii, P. fruticosa*, *P. parvifolia*) of *Potentilla* L. were listed in the conspectus (Gundegmaa, 2014), but should be excluded from the flora of Mongolia.

We are adding new distributions of 10 species to the phytogeographic regions of Mongolia. There are 12 species of endemic and 17 species of subendemic are distributed in the our country.

This is a comprehensive revision of the taxonomic study of genus *Potentilla* L. consist of 83 species and 2 subspecies (14 sections of 3 subgenus) to the flora of Mongolia.

Genetic diversity of the Mongolian horse populations in various geographical regions

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Genetic structure in Mongolian horse populations from different geographical areas were investigated using genetic polymorphism of DNA-ACC- and GAG-JSSR marker types and mtDNA haplotypes. Estimation of the genetic polymorphism of DNA- ACC- and GAG-JSSR marker types in Mongolian horse showed. 19 alleles of ACC-JSSR marker and 14 alleles of GAG-JSSR marker were distributed in Gobi and 14 alleles of ACC-JSSR marker and 12 alleles of GAG-JSSR marker in the highlands region. Distribution of these DNA-JSSR alleles in Gobi and highland analyzed using STRUCTUR v2.2 and 2.3.3 software has demonstrated that these populations differ substantially.

The mitochondrial DNA (mtDNA) control region sequences of Mongolian horses from various geographical zones were analyzed. High mtDNA sequence diversity

in Mongolian horses were observed. Analysis of the mtDNA control region from Mongolian horses revealed 53 haplotypes and significant different distribution of these haplotypes in the horse populations from various geographical regions.

In vivo **and** ***in vitro*** **comparative study of secondary metabolites and antioxidant activity of** ***Paeonia lactiflora*** **Pall.**

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The genus *Paeonia* has received considerable attention from scientists, as it contains the root and aboveground parts of traditional medicinal products. In China, Korea, Japan and Mongolia, a decoction of the dried root without bark of *P. lactiflora* Pall., is used in the treatment of rheumatoid arthritis, hepatitis, systemic lupus erythematosus, dysmenorrhea, muscle cramping and spasms. We have raised callusses from leaf and root explants. Calluses were induced from leaf and root explants on Murashige and Skoog (MS) medium supplemented with 0.5mg/l thidiazuron, 0.2mg/l 2, 4-D and 0.5 mg/l gibberellin. Calluses and plant parts (root, leaf) of *P. lactriflora* used for quantitative estimation of secondary metabolites and antioxidant activity. The simple phenolic content was determined by spectrophotometry, using Folin-Ciocalteu reagent, and the content of total flavonoid was determined using an aluminum chloride colorimetric assay. The antioxidant capacity was evaluated by analyzing the scavenging capacities of free radicals of 2,2-diphenyl-1-picrylhydrazyl (DPPH). The antioxidant activity and secondary metabolites of the leaf, leaf callus, root and root callus of this plant was investigated using its methanol extracts. Simple phenolic and total flavonoid contents was about higher in the leaf callus than in the leaf extracts and was about lower in the root callus of *in vitro* than in the leaf extracts of *in vivo.* Leaf and root extract showed higher 2,2- diphenyl-1-picryhydrazyl (DPPH) free radical scavenging activity (97.4±0.5% and 60±1.3%) than leaf and root callusses (23.4±0.8% and 16.4±0.3%).

Cloning of ***farnesyl pyrophosphate synthase*** **and** ***CYT P450 monooxygenase*** **involved in artemisinin biosynthesis in** ***Artemisia annua*** **L.**

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Artemisinin, a sesquiterpene lactone endoperoxide derived from *Artemisia annua* L., is the most effective antimalarial drug. *A. annua* belongs to the plant family of *Asteraceae* and is an annual short-day plant, and the only natural source of artemisinin. However, the artemisinin content in leaves is relatively low (0.1–0.8% by dry weight). Besides their antimalarial activity, artemisinin was also recently been reported to possess antiviral and anticancer functions. Owing to the tight market and low yield of artemisinin, there is great interest in enhancing the production of artemisinin. The artemisinin biosynthetic pathway is gradually being understood as the genes involved in artemisinin biosynthesis are identified. Farnesyl pyrophosphate synthase (*FPS*) and Cyt P450 monooxygenase (*CYP71AV1*) identified in *A. annua* are two key enzymes in the artemisinin biosynthesis pathway.

In this study, full-length cDNA of *FPS* and *CYP71AV* genes were cloned from *A. annua*. Total RNA of *A. annua*. was extracted from leaves using TRIZOL RNA extraction protocol. The total RNA was examined by electrophoresis in 1% agarose gel and its concentration was determined by spectrophotometry (NanoDrop 1000). Single-strand cDNA was synthesized from isolated total RNA using Reverse transcription protocol. The target gene sequences were collected from NCBI database. PCR programs were optimized for amplifying the target genes (*FPS* and *CYP71AV1*). The purified PCR products were cloned into pCR8/GW-TOPO vector and into *E. coli* DH5α competent cells using pCPR™8/GW/TOPO®TA Cloning Kit®. The completed open reading frame of *FPS* and *CYP71AV1* were 1032 bps and 1488 bps.

Biological activity of *Saussurea amara* (L.) DC.

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The medicinal application of specific plants for long periods in traditional medicine suggests the presence of biologically active substances in these plant species. *Saussurea amara* (L.) DC. is a wild plant with high feeding value for its high protein content, vitamins and minerals. *S. amara* is used in traditional Mongolian medicine for the treatment of hepato-biliary disorders. The goal of our study was to evaluate the antioxidant and antimicrobial activities of *S. amara*. The antioxidant capacity of a methanol extract of plants was evaluated by analyzing its DPPH free-radical scavenging activity, reducing power and determination of total phenolic compounds. The free-radical scavenging activity of the *S. amara* was estimated by using a previously described method by Blois, 1958. The quantity of reduced DPPH, which formed a yellow color, was measured in term of absorbance at 517

nm in a UV-Visible spectrophotometer. The reducing power was determined by a previously described method (Oyaizu, 1986). The absorbance was measured at 700 nm in a UV-Visible spectrophotometer to estimate the quantity of Fe^{++}. Total soluble phenolic compounds were determined as described previously (Slinkard and Singleton, 1997) using pyrocatechol as a standard. The absorbance at 760 nm was measured. In the experiment of DPPH, the IC_{50} for the commercial standard BHA was 4.4±0.41 µg/ml. *S. amara* has weak antioxidant activity by DPPH, FRAP and TPC respectively that, IC_{50} value was 346±6.03 µg/ml, 12.90±0.42 µg equivalent to 1 µg BHT and 49.03±0.81µg equivalent to 1 µg pyrocatechol. Antimicrobial assays of the test extract were performed 3 clinical microorganisms, including Gram (+) positive (*Staphylococcus aureus* KCTC 3881), Gram (-) negative (*Escherichia coli* KCTC 1039) bacteria and 1 fungus (*Candida albicans* KCTC 7965). All strains were purchased from Korean Collection Type Culture (KCTC), Deajeon, South Korea. Bacterial strains were grown on nutrient agar (NA) at 30-37 °C and *C. albicans* was grown on yeast mannitol (YM) agar at 25°C. The qualitative antimicrobial test was performed by the paper disk diffusion assay as described previously (Bhattarai et al. 2006) to measure the zone of inhibition of the target microorganism. *S. amara* has 2 antibacterial (*S. aureus, E. coli*) activities. We have separated the water and dichloromethane (DCM) fractions of *S. amara* and we have checked of antibacterial activity of 2 mg/40 µL extract of both fractions. This result showed that water fraction of *S. amara* has no antibacterial activity, but DCM fraction has 2 antibacterial (*S. aureus, E. coli*) activities. The inhibition zones of *S. aureus* and *E. coli* respectively that, 38±0.2mm and 14±0.1mm. This result showed that *S. amara* with the strongest antibacterial activity and need to do narrow study for screening of natural compound.

Asian ochotonids (Ochotonidae, Lagomorpha, Mammalia): biodiversity, biochronology and dispersal.

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Ochotonids are originated in the Paleogene period in Central Asia and have long history of life from the Oligocene to the Recent. At present time ochotonids are represented by the sole extant genus *Ochotona* restricted mainly to Asia (26 species), two species inhabit North America and one occupies small area in the Europe. However, in the past it was extremely abundant group. The earliest records are represented by the genus *Sinolagomys* known from the end of the Early Oligocene in Asia. At the beginning of the Miocene a wide adaptive radiation of ochotonids took place, advanced rootless *Sinolagomys* continues to exist in Asia and new genera

Bellatona and *Bellatonoides* appeared in the region. Ochotonids migrated to North America (*Oreolagus*), Africa (*Kenyalagomy*s) and flourished in the Europe, which is characterized by highest ochotonid genera diversity (*Proochotona, Paludotona, Lagopsis, Albertona*, *Marcuinomys*). These data suggest that intensive interchange of the world faunas occurred because the landscapes and paleoenvironment of Northern Holarctic were favourable to the wide distribution of mammals.

At the early Late Miocene the aridity of the climate traced over the world that led to the formation of steppe zone in Eurasia and at that time the origination of the genus *Ochotona* occurred. Explosive radiation of *Ochotona* and their flourishing took place during the Pliocene in Asia. They were abundant both in taxa and in number of specimens. At the mid of Pliocene with rapid expansion of microtines which became as herbivorous an alimental competitors of pikas, ochotonids became decline their number of taxa and quantity. The formation of modern taxa took place during the Late Pleistocene and Holocene.

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Biochemical composition of the carcass meat and fat of Muskrat (*Ondatra zibethicus* LINNAEUS, 1766) in Mongolia

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For a long time muskrats were known as animals of economic importance in fur production as well as in breeding business. Semi-aquatic muskrats are very important as marsh managers, removing extra plants and making sure waterways are clear. The acclimatization of muskrats in Mongolia started in 1967-1979 (Dash and Shagdarsuren, 1993). We caught 3 male and 2 female muskrats in the depression of Uvs Lake.

The main goal of this study was to determine biochemical composition of carcass meat and its fat of the muskrat such as moisture, protein and fat content, ash, protein amino acids and some saturated and unsaturated fatty acids. The fat content of carcass meat was very low in both male and female invasive muskrats. The carcass meat lipids of the muskrat contained fatty acids ranging in chain length from 16-18 carbon atoms. The average amount of moisture was 74.6%, the content of protein was 23.2%, raw-fat was 1.22%, ash was 0.92%, and the average amount calorie was 112.2 kcal/100g meat.

The authors were determined in hydrolyte of carcass meat of muskrat 17 protein

amino acids. Seven amino acids of their irreplaceable (essential) amino acids. There are not produced in the body and must be supplied by food. Total lipids were isolated from the carcass meat by a modified method proposed by Folch et al., 1957 and used apparatus by High Pressure Liquid Chromatography (HPLC). The objective of the present study was to determine the fatty acid (FA) composition in the total lipid revealed the presence saturated fatty acids palmitic acid (C16:O) and stearic acid (C18:O), unsaturated fatty acids oleic acid (C18:1), linoleic acid (C18:2), and linolenic acid (C18:3). In addition, histological study was measured in thigh and forelegs carcass muscle of the muskrat. From mouth to mouth between some peoples of the west province (Uvs and Khovd) have been used for food a carcass meat of the muskrats (for treatment renal illness).

Study on *Paeonia lactiflora* Pall. cultivated in Mongolia

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An indigenous herb, *Paeonia lactiflora*, has been widely used as a traditional medicine in Mongolia. The purpose of the study was to determine plant primary metabolites: the content protein, total saccharides, cellulose, raw oil, mineral elements, total carotene, some vitamins, enzymatic activity: peroxidase, catalase, lipase and *O*-diphenoloxidase. Plant secondary metabolites were determined the contents of extractive substances, phenolic compounds: tannin, anthraglycoside, and total flavonol in above-ground and underground parts of the *Paeonia lactiflora* Pall. Moreover, we investigated the antioxidant activity only in aerial parts and antibacterial activity in various extracts including 95% ethanol, methanol, ethyl acetate, n-butanol, acetone and hexane of different parts of *P. lactiflora*.

We studied the antihyperlipidemic activities of the 10 extracts of aerial and root parts of *P. lactiflora*, determined total cholesterol (TC), triglyceride (TG), low-density lipoprotein (LDL) and high-density lipoprotein (HDL) activities in blood serum rats. Serum was separated from blood rats TC, HDL, LDL and TG were measured by using appropriate kits supplied by Biosino bio-technnology and science INC.

Then, the purpose of the study was to test the blood coagulation assays of the aqueous and alcoholic extracts of the *P. lactiflora*. In biological systems, coagulation is often the result of denaturing proteins in solution. An aqueous and ethanol extracts of aerial and root part of *P. lactiflora* were evaluated in Kumming-strain mice. Internal and extrinsic coagulation assays of aqueous and ethanol extract of *P. lactiflora* in a similar volumes (50 mg/kg) were examined on the blood samples of normal

individuals by measuring clotting time. Average internal and extrinsic clotting time of injected aqueous and ethanol extracts of different parts of *P. lactiflora* compared with average control group were shortened 35 sec (approximately 56%) and 17 sec (approximately 70%).

Body Size Variation and Sexual Dimorphism of Dung Beetle, *Gymnopleurus mopsus* (Coleoptera: Scarabaeidae) across different habitats in Mongolia

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A dung beetle, *Gymnopleurus mopsus* (Pallas, 1781) inhabits the various types of domestic and wild herbivore dungs and patchily distributed in the Mongolian pasturelands. Morphometric variation in sexual dimorphism and body size variation are poorly understood for *G. mopsus*. In this study, we examine relationships between body characters within sexes and compare between the body size variation among populations from different habitats, mountain steppe and semi-desert. A total of 465 specimens were sampled at seven localities collected between 2014 and 2017, and measured nine body character of adults: total body length and width, head length and width, distance between eyes, pronotum length and width, and elytra length using a calliper to the nearest 0.1 mm with a low-magnifying binocular microscope. Male genitalia sizes were measured with three dimensions: length, width and height. The analysis was performed by one-way ANOVA and subsequently ranked by Tukey's test for significant differences and the t-test for the correlation coefficient, using *R* program. As a result, all body characters were not significantly different between females and males ($p<0.5$), and were highly relationships to each other within sexes. Comparative analysis suggested that an average body size was significantly smaller in the mountain steppe than that in the semi-desert. However, the genitalia length and height were larger in the mountain habitats. In conclusion, there was no significant difference between males and females.

Some data on feeding preference of *Gymnopleurus mopsus* Pallas, 1781 (Coleoptera: Scarabaeidae)

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Adults of most *Gymnopleurus* species feed on fresh dung of herbivorous mammals. These beetles have feeding preference for a various type of dung resources depend on differences in physical and chemical compounds, and pastures. We conducted to examine a feeding preference of *G. mopsus* to dung pad of camel, cow, wild and horses in laboratory. Specimens were collected from four different assemblages in mountain steppe, semi-desert and desert pasturelands. The laboratory experiments consisted of a glass container (50 x 50 x 30 cm) with dry sandy soil, and installed a video camera. Specimens were randomly selected and labeled on their elytra and pronotum. During the feeding experiment, room temperature was at 26±2°C and relative humidity (RH) 40±2% in a darkened and lighted. Before each experiment, 50 g fresh dung was placed into two differently shaped places, which separated by a plastic chamber. Finally, beetles brought in the testing container and observed to feeding preference for six different dung combinations, each was repeated 3 times at different hours. In results, beetles were significantly more attracted to horse dung than other types, and then similarly preferred for camel and cow dung. But, the beetles were weakly attracted to dung of wild horses. Furthermore, it needs to continue a field observation in different pasture habitats.

Arsenite-oxidizing bacteria isolated from mining soil in Mongolia

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Arsenic is a toxic metalloid naturally found as inorganic oxyanion arsenate As(V) and arsenite As(III) species. As(III) is considered to be 25–60 times more toxic than arsenate As(V). The potential detoxification processes of arsenic by microorganisms may be related to arsenic resistance system gene (ars), arsenic respiratory reduction genes (arr), or arsenite oxidation genes (aox etc.).
The bacterial strain used in this study was isolated from heavy metal such as arsenic contaminated mining soil samples at Zaamar, Mongolia. The 11 arsenic-resistant strains investigated in this study were previously from accumulated soil (AsIII

oxidizing at> 0.15mM/day). Accumulated soil were diluted into 20µl of $\times 10^{-4} \sim \times 10^{-2}$ (0.5g/500 µl mSSE) and streaked on the plate R2A agar (2%) with AsIII (0.15mM) at 25 ± 2^0C for 48 h. Singlization of pure cultures were obtained four times by streaking successive isolation of colonies under the same conditions and picked them up every day a week. The microplate screening method was used to test 11 strains isolated from arsenic contaminated environments, for the arsenic transformations, both reduction and oxidation. This method is based on the formation of white colored precipitates at pH 6.5-8.5 upon reaction of $AgNO_3$ with Tris-HCl. Precipitates containing arsenic were colored from light yellow of Ag_3AsO_3 (silverorthoarsenite) from the As[III] to light brown-red of Ag_3AsO_4 (silverorthoarsenate) from the As[V] [4]. To optimize the contrast between the two basic precipitate colors (light yellow silverorthoarsenite and light brown-red silverorthoarsenate) and their color intensity concentration of $AgNO_3$ (0.1 M) and Tris-HCl (0.2 M) were tested. The greatest contrast and intensity were observed when above mixture in equal volumes (100 µl). Complete oxidation of As[III] to As[V] was detected by the presence in the column As[III] of a brown-red precipitate corresponding in the color scale to the ratio As[V]/ As[III]=75/100. The formation and differentiation of the colors developed similarly some of them and differently some. For molecular analysis, total DNA was extracted of bacterial strains using the PowerSoil® DNA Isolation Kit (MoBio, Carlsbad, CA). For the denaturing gradient gel electrophoresis (DGGE) analysis, 16S rRNA gene fragments were PCR-amplified using *Bacteria* –specific primer 1070F and the universal primer 1392R containing a GC-clamp, and followed by separation of qRT-PCR product using DGGE. Sequences were assembled using Sequencer 4.1 (Gene Codes Corporation, Ann Arbor, MI) and compared to the GenBank database using BLAST.

In this study, it was shown that some of the bacterial strains isolated from the mining soil, strains of genus *Arthrobacter* sp. (99% 16S rRNA sequence identity), *Rhizobium* sp. (99% 16S rRNA sequence identity) and *Bosea* sp. (88% 16S rRNA sequence identity) had ability to utilize high concentrations of arsenite up to 10 mM under aerobic condition.

Bacterial communities of Khubsugul Lake water determined by Phylochip analysis

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In this study, the group of bacteria in Lake is determined. Using a high-density

microarray (Phylochip), we examined water column bacterial community DNA extracted from 5 sampling sites of the Khubsugul Lake. The Phylochip microarray probe design approach described was extended and re-applied to all known high-quality 16S rRNA gene sequences containing at least 1,300 nucleotides. Sequences were extracted from the NAST multiple sequence alignment available from the 16S r RNA gene database, greengenes.lbl.gov. This region was selected because it is flanked by universally conversed segments that can be used as PCR priming sites to amplify bacterial or archaeal genomic material using only 2 to 4 primers. Filtered rRNA gene sequences were clustered to enable selection of perfectly complementary probes representing each sequence of a cluster. Putative amplicons containing 17-mers with sequence identity to a cluster were included in that cluster. The resulting of the clusters was considered operational taxonomic units (OTUs).

For the result of this study, the OTUs represented 50 phyla (classified 49 and unclassified 1), 101 subphyla, 159 classes, 143 orders and 145 families. Phylum *Proteobacteria* was dominated for 51.8% and subphylum γ-*proteobacteria* was occupancy 43.5 %, which shown higher amount of the organic matter in the lake water. Distributions of detected operational taxonomic units (OTUs) at the class level were compared among all sampling sites. The top 10 classes with the highest standard deviations were (in descending order): *Betaproteobacteria, Arthrobacter, Aeromonadaceae, Streptomycineae, Pseudomonadaceae, Akkermansia, Sphingomonadales, Flavobacteriales, Clostridiales* and *Staphylococcaceae.* Of those classes, only *Betaproteobacteria, Arthrobacter* and *Aeromonadaceae,* had higher relative richness at sampling sites, (which absolutely lower of the anthropogenic influence). We focused on sampling site Khu-3, tourist camping area, where detected 3500 OTUs and dominated by following bacterial phylum: *Proteobacteria* 51.8%, *Actinobacteria 24%, Firmicutes 7.7%, Bacteroidetes 5.8%, Verrucomicrobia 3.5%* and *Cyanobacteria 1.7%.*

This study provided a characterization of bacterial community variability during dry weather across fall season, in the Khubsugul Lake. The comparative analysis of Lake water community composition resulted in alternative community-based indicators that could be useful for assessing ecosystem health. This study funded by Foundation of Technology and Sciences in Mongolia and was performed at Lawrence Berkeley National Laboratory, CA.

Moths as bio-indicators of grazing impact in Mongolian rangelands (Lepidoptera: Heterocera)

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Overgrazing has become an ecological problem in the wide steppes of Mongolia due to rapid livestock growth in the last decades. Species diversity and productivity of biological communities, along with information on the presence and absence of certain species, can be indicators of the environmental state of pasture. Moths are abundant in many different habitats and sensitive to environmental changes. We used moths as indicators for pasture degradation in the Mongolian steppe for the first time. In this study, we collected a total of 115 species from Ikhtamir and Undurshireet, two locations in central Mongolia, and compared moth diversity in plots with different grazing intensity. Species diversity of moths was two times higher in lightly grazed plots than in medium-grazed and heavily grazed plots, demonstrating that pasture degradation affected moth diversity negatively. We identified four indicator species for heavily grazed plots (*Leucoma salicis*, *Autographa buraetica*, *Mythimna impura* and *Pelochrista arabescana*) and seven indicator species for lightly grazed plots (*Panchrysia dives*, *Gastropacha quercifolia*, *Selagia argyrella*, *Lymantria dispar*, *Mythimna conigera*, *Stigmatophora micans* and *Perconia strigillaria*). The meadow moth *Loxostege sticticalis* was most abundant in all plots.

Contribution to the knowledge of the flora of the Munkhkhairkhan mountain area, Mongolia

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The Munkhkhairkhan mountain area is a unique highland ecosystem, which has a diverse regional alpine flora. This mountain habitat is located at the overlap of different floristic regions: on its western side, the Kazakhstan–Turan flora is dominating and, on the eastern side, species of the East-Asian flora are observed. It is known that the whole area has a large number of endemics and rare plant species, because of its specific, harsh habitat conditions. Therefore, the flora of different habitats in the Munkhkhairkhan mountains needs to be investigated and properly protected. The Munkhkhairkhan National Park was founded in 2006 and our survey concentrated on the protected area as well as comprised the surroundings of the mountains. All records of plant species in this study are based on collected voucher specimens. The conservation status for remarkable species was assessed with help

of the literature. As a result, we recorded 40 families, 150 genera, and 267 species of vascular plants, including four endemic and 34 subendemic species. In addition, we provide notes to the distribution of 15 species. Around the Munkhkhairkhan mountains, 16 very rare (VR), 21 rare (R), eight endangered (EN) and two near threatened (NT) species were found, indicating the high conservation value of this area and the necessity for further research.

Physical habitat structures and aquatic community characterizations of the glacier and snow fed Bulgan River in Western Mongolia

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There is a lack of classification of stream types in Mongolia. A linkage between stream types and aquatic community is a base for the assessment of the physical condition of rivers and planning of physical rehabilitation. In this study, Rosgen classification, a geomorphic approach to the classification of natural river types used for the first time to characterize the Bulgan river reaches. Physical habitat data and biological assemblages including diatoms and aquatic macroinvertebrates are collected using Environmental Monitoring and Assessment Program protocols for wadable rivers at 5 sites along the river.

According to geomorphology, upper reaches of Bulgan River classified as a D4 type which is a glacial outwash valley, middle reaches shifted to a narrow valley controlled by gorge and colluvial-alluvial deposits which belong to the B4c type, finally the it becomes C4, DA4 and G5c types of stream with broad valley at downstream. Stream types significantly associated with differences in biological assemblages. Distinct biotic communities observed at five sites representing 140 species for diatoms and total 6280 individuals of benthic macroinvertibrates representing 73 genera, 22 families and 7 orders. Detailed analysis of the communities will be presented.

Species Composition and Nesting Habitats of Ants in the Bogdkhan Mountain, North Central Mongolia

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The ants of the Bogdkhan mountain region, north central Mongolia, have been studied by Dlussky (1965), Pisarski (1962a, b), Dlussky and Pisarski (1970), Pisarski and Krzysztofiak (1981). They recorded 26 species belonging to six genera in two subfamilies. However, since the 1990s, several important taxonomic papers on the ants of the northern Palaearctic region have appeared (e.g., Seifert, 1992, 2000; Radchenko, 2004), with descriptions of new species and changes in name and taxonomic status. Pfeiffer *et al.* has listed all the known species of ants from Mongolia, but localities for each species are often not stated.

Since 2001, we have been conducting research on ants of Bogdkhan Mountain. Our data are based on colony collection and thus provide information on nesting habitats of ants in this mountain. Since we did not examine the materials used in the studies by previous authors, it was not easy to match the species names between our list and theirs. Here we present the list of ants collected by us with information on nesting habitats.

The Bogdkhan mountain (47^{0} 45' N, 107^{0} 11' E) is located at the southwestern boundary of the Khentii Mountain range in north central Mongolia, and characterized by cold winters, cool summers and sharp continental climatic features. In Bogdkhan mountain system four vegetational subzones, i.e., alpine taiga, alpine forest, forest steppe and steppe, are recognized. Ants were collected from several gullies of the mountain. Colonies were found by searching the ground surface and nest site types were recorded.

Twenty four species belonging to seven genera were collected. All the species belong to subfamily of Formicinae and Myrmicinae. The most species genus was *Formica,* of which eleven species in three subgenera were found. Ants were collected from a total of 260 colonies. Three types of nesting were recognized. 1). Nests with a mound on the ground level 2). Nests under stones and logs 3). Nests in dead/rotting twigs or stumps.

A social parasite of *Leptothorax* species, *Harpagoxenus zaisanicus,* originally described from the Bogdkhan mountains, was not collected this time. Nesting types of ants are systematically reported for Bogdkhan ants for the first time. We recorded eight new species to Bogdkhan Mountain ant fauna.

Morphological studies on fruits of some genera of the family Boraginaceae in Mongolia

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Boraginaceae is the largest plant family in the world, consisting of 115 genera, which include 2500 species. Species of Boraginaceae are distributed throughout all botanical-geographical regions of Mongolia. The family is very significant in the grasslands. The study used 2000 herbarium specimens. Plants were collected during field courses and botanical expeditions in the scope of the "Morphologycal study of pollen and spore in Mongolia" project from 2006-2016. These specimens were deposited in the Herbarium of the Laboratory of Palynology at the Mongolian National University of Education. Morphological characters of the fruits of 19 species from 11 genera of Boraginaceae in Mongolia were examined using a dissecting scope (MBS-10). Fruit morphology of the examined specimens exhibits some variation in size, color, shape and surface ornamentation (Oznur & Riza, 2011). Nutlets are ovoid in *Tournefortia* L.; ovoid-globose in *Amblynotus* Johnst., *Myosotis* L.; reniform in *Nonea* Medic.; ovoid-trigonous in *Lappula* Fabr.; densely, echinulate with glochidia, depressed-ovoid, with outer surface convex in *Cynoglossum* L.
According to surface ornamentations, five main types, smooth **(***Amblynotus rupestris* (Pall.ex Georgi) M.Pop.ex Serg., *Myosotis caespitosa* C.F.Schultz, *Myosotis sylvatica* (Ehrh.) Hoffm., *Myosotis suaveolens* Waldst.et Kit., *Eritrichium villosum* (Ldb.)Bge., *Eritrichium pauciflorum* (Ldb.)DC.), reticulate, rugose (*Nonea pulla* (L.)DC., *Nonea caspica* (Willd.) G.Don.), colliculate (*Anoplocaryum compressum* (Turcz.) Ledeb., *Arnebia guttata* Bunge*., Arnebia fimbriata* Maxim*., Mertensia davurica* (Sims) G.Don f., *Mertensia stylosa* (Fisch)DC.), margin of abaxial surface usually with 1(-2) rows of glochids **(***Lappula consanguinea* (Fisch. et Mey.) Guerke., *Lappula granulata* (Kryl.) M.Pop., *Lappula intermedia* (Ldb.)M.Pop., *Hackelia deflexa* (Wahlenb.) Opiz*,* and fluffy **(***Tournefortia sibirica* L.), were defined and illustrated.
Morphological features of fruits of some species in Boraginaceae could be useful in solving some taxonomic problems.

Population structure and biodiversity of shrews in mountain forest area of Khonin Nuga, Western Khentey

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There are many research areas in Khonin-Nuga, one of them being the population and structural research of small mammals. The aim of this study is to determine diversity of species, population ecology and distribution of shrew communities in the mountain forest area of Khonin-Nuga. The research was conducted from 2000 to 2012 (July-August). Pitfall traps were used as the preferred method of catching; traps were placed in 5 habitats (herb meadow, mountain dry steppe, mixed forest, Betula bush and flood plain) of the mountain forest area of Khonin-Nuga. During the research time 413 shrews of 5 species were caught (*Sorex caecutiens* n=225, *Sorex daphaenodon* n=186, *Sorex isodon* n=66, *Sorex minutissimus* n=1, *Sorex roboratus* n=13, *Sorex tundrensis* n=3) in total. The study revealed that species diversity were the highest in humid areas such as *Betul*a bush and mixed forest habitats while the lowest was in mountain dry steppe habitats. In most habitats *Sorex caecutiens* was the dominant species followed by *Sorex daphaenodon*. Population dynamics were asynchronous highly relative to winter climate.

Examination of new technology to assess the diet and behavior of Takhi: camera attached on GPS telemetry collar

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The Przewalski's horse (*Equus ferus przewalskii* (Groves, 1886)) became extinct in the wild in the 1960s, but survived as a species due to captive breeding. There have been several initiatives to re-introduce the species in Central Asia. There is a bunch of research work's about Przewalski's horse, but we were studying about their behavior and diet, spatial pattern etc. We collared two Przewalski's horses from one group: Tsagaanaa and Boroo in Erhes group. Between 10 June and 12 September 2013 our data were collected by camera-collar (camera attached on GPS telemetry collar) from Great Gobi B SPA. The camera collar took a photo every hour

between 08AM to 07PM. We are categorized all picture data. For example: How many horses in image? And behavior of horses in image, vegetation type, landscape, picture orientation, quality of image, weather and other etc. We were using that technology we can understood about Przewalski's horses time budget, behavior, spatial pattern. On the other hand, we can do species distribution modelling and we can choose new re-introducing places on that rare mammal species.

New records for the flora of Khar Yamaat Nature Reserve

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Khar Yamaat Nature Reserve located on the territories of Khentii and Sukhbaatar aimags. The Khar Yamaat Mountains are composed of the Khar Yamaat, Tument-sogt, Turuu Ondor mountains. The Khar Yamaat mountains are a meeting point for wildlife representatives from the Manchurian, Dahurian, and Central Mongolian ecoregions. This mountain habitat is located in the overlap of different floristic regions: Northern and Siberian plant species are dominate and Dahurian, Manchurian, and Eastern Mongolian flora elements are observed.

The formation of the Khar Yamaat mountains and its range of biological diversity are unique ecosystems in the eastern Mongolia. Therefore, the flora of different habitats in the Khar Yamaat mountains needs to be investigated and properly protected. The Khar Yamaat Nature Reserve has been founded in 1998, and our survey concentrated on the protected area. According to the agreement made with the Ministry of Environment and Green Development and Khentii and Sukhbaatar aimag governments, the WWF Mongolia is responsible for conservation management of Khar Yamaat Nature Reserve (NR) in the eastern region. In frame of the above agreement, we conducted vegetation monitoring research in this area.

As a result, we recorded 240 species of vascular plants of 158 genera and 62 families and 24 species recorded in newly in distribution of Dundad Khalkha region and 17 species' new location remarked in Khar Yamaat area. 11 sub-endemic species, 1 relict species, 4 very rare and 20 rare species are growing in Khar Yamaat Nature Reserve.

According to our research, diversity of shrubs is more than 10 percent in total plants diversity and it is another special characteristic of the vegetation in Khar Yamaat mountain area.

Effects of fire on the small mammal communities in the Khar-Yamaat Natural Reserve

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Fire is a natural dynamic process that is integral to maintaining ecosystem function. In addition, it is an important ecological factor in semidesert grass-shrub community dynamics. Therefore, small mammal populations did not recover quickly in burned areas due to the lack of cover during the first year. Khar Yamaat Nature Reserve lies on the junction of territories of the Khentii and Sukhbaatar provinces. In the year of 2015, the fire occurred in the region. We studied the consequences and effects of fire through the collaboration with WWF in 2016 and 2017 based on the previous data from 2000, 2001 and 2002. Our study areas have been used in more recent studies, therefore, in order to compare the effects of fire on small mammal populations in burned and unburned how different between on time series, we compared population abundance (expressed as an index of relative abundance), species richness (*S*) and species diversity (expressed as Shannon and Pilou indexes) of small mammal assemblages.

The results showed that population abundance, species composition (but not species richness) and species diversity were affected by the fire process. We observed no effect on species richness, but decreasing diversity due to a greater abundance of the more specialist species, such as *A. penisulae* and *C. barabensis*, the latter only present in the most natural areas. Strong negative associations of mammal abundance and richness with frequency of late dry season fires.

Comparative study on biodiversity of the Daurian Steppe

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The area most affected by economic activity in Mongolia is the steppe ecosystem. Intensity of land use is heavily negative impact on degradation of steppe ecosystems than climate change.

One of the main indicators of ecosystem status is biological diversity. In other words, the sustainability of ecosystems is directly dependent on diversity of species in the ecosystem. Researchers have reported that pasture degradation and desertification have been intensified due to climate change and its use. For example, researchers say that 70% of pasture in Mongolia is degraded. However, the degradation of pastures is only a sign of vegetation. Pasture degradation is not assessed as biodiversity

characteristics other than plants.
Therefore, this study was conducted with the main objective of assessing the sustainability and biodiversity of ecosystems in the field of assessing the grazing intensity of grassland ecosystems. The survey was selected in the steppe region of Norovlin and Batnorov soums of Khentii aimag for 2012-2014 for the same period of the year.
Our finding say that biodiversity was greatly different in the degraded and non degraded areas. For example, there were 26-41 species in degraded habitats, but 61-65 species of plants in non-degraded habitats. Compared to the microartropod species of soil, there are 46 species of soil microartropods in low-grade meadow areas, and the 35 species is in degraded habitats. Density of microarthropods in non-degraded habitat was 88400 individuals, and 51600 individuals were in degradation. Compared by butterfly community, 39 butterfly species were recorded in mountainous steppe habitats and 52 butterfly species were recorded in meadow of not degraded habitat. But 29 butterfly species in high mountainous areas and 27 butterfly species were recorded in degraded habitat. There were only 25 species in the two moths in the night butterfly, but the number of the individuals was high in low use habitat. Compared to the composition of the small mammal species, the small-numbered species are: 10-11 species in low use environment, and 6-7 species in high-use environments, and fewer species such as Brantd's voles.
Our study demonstrates the use of micro-living organisms, butterflies, vascular plants and small mammals as criteris for evaluating the degradation is valuable in the steppe ecosystems.

Preliminary results on impacts of mine activities on small mammals communities in the Gobi region of Mongolia

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In the Gobi region of Mongolia, the mining activities have been developed rapidly in recent years. The development of mining sector is important on economic growth of Mongolia, but local communities have always critisized for negative impact of it. The purpose of our study was to determine whether the mining affects on the small mammals community in the Gobi region. In order to achieve this goal, we estimate the abundance of small mammals in the vicinity of Tavan Tolgoi and Oyu Tolgoi mines in Umnugovi aimag in August 2017.
Estimating the abundance of small mammalian populations in the area and attempting

to determine whether the minings have negative impacts on small mammals by comparing their results. The Sherman-medium-sized traps were used in this study, with a total of 2357 trap/nights running .

We captured 419 individuals of 14 species including, Mongolian gerbil (*Meriones unguiculatus*), Midday gerbil (*Meriones meridianus*), Mongolian hamster (*Allocricetulus curtatus*), Grey hamster or Grey dwart hamster (*Cricetulus migratorius*), Campbell's hamster (*Phodopus campbelli*), Roborovski's hamster (*Phodopus roborovskii*), Long-eared hedgehog (*Hemiechinus auritus*), Gobi jerboa (*Allactaga bullata*), Siberian jerboa (*Allactaga sibirica*), Hairy-footed jerboa (*Dipus sagitta*), Balikun jerboa (*Allactaga balikunica*), Five-toed pygmy jerboa (*Cardiocranius paradoxus*), Thick-tailed pygmy jerboa (*Salpingotus crassicauda*) and House mouse (*Mus musculus*).

The small mammals abundance on per 100 trap/nights is 12.4 in the around of Tavan Tolgoi, and 5.0 in the Oyu Tolgoi mine. However, the abundance of small mammals per 100 trap/nigths was 28.7 in the uninhabited desert area. The Mongolian gerbil dominates around the Tavan Tolgoi mining within the period covered by the study, but Roborovski's hamster dominate in areas where there are no mining activities.

According to our findings, the abundance of small mammals has been characterized by the density of roads, high mobility and noise in the area around the mines, but the abundance of populations of small mammals has been high in the silent desert. According to this, mining activities in the Gobi region have negative impacts on small mammals communities. However, the results of this study show that this is differently affects tte various species of small mammals.

Some notes of distribution of Eurasian otter (Lutra lutra L., 1758) in Tes river basin, Mongolia

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Eurasian otter is distributed in the valley of Bulgan gol, Khalkh gol, Numrug gol, valley of Tengis and Shishkhed of Darkhad basin and Eruu gol of West Khentii in Mongolia. Moreover, this species also occurrs in Egiin gol, Khurimt gol, Khoton-Khurgan Lakes of Mongolian Altai, Onon-Balj gol.

Rangers and officers of Uvs Nuur Strictly Protected Area are recorded first time Eurasian otter from Namryn gatlaga in Jiree Gol basin and a mouth of Tes river during their field work in January, 2013. Eurasian otter was killed by dog close to the river bank and water hole, which used by local people for watering their livestock. The measurement of this deal animal was as follows: body length – 80

cm, tail length – 39 cm, ear length - 1.5 cm. The habitat of Eurasian otter in this region being more densy plants with kharagana and willows, and relatively lowly elevated at 800 m a.s.l.

Understanding and developing community awareness of Pallas's cat (*Otocolobus manul*) in Mongolia

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The preservation of biodiversity through conservation of species and habitats in any country is a complex and challenging process. Without a basic understanding of the environment the challenge to conserve it can be even greater. In Mongolia iconic species like the Snow leopard (*Pantheraunica*) or Przewalski's horse (*Equusferusprzewalskii*) are widely known from both within and out-with the conservation community. For smaller less iconic species, for example the Pallas's cat (*Otocolobus manul*)this is not the case. Pallas's cat is one of the near threatened species in Mongolia, as well as in the World. This species is distributed in the most of regions of Mongolia except Taiga,the populationis dramatically declining due to poaching, habitat loss and mining exploration in Mongolia.

Although Mongolia is a recognized stronghold for the species there is still a great lack of understanding of what they are, where they are found, their role in the environment, threats to their populations, their conservation status and their need for conservation. Using standardized surveys we conducted interviews from 130 herders living in the Gobi GuvanSaikhan Natioanl Park for Pallas's cat presence to document awareness, attitudes and knowledge of the species. Following interviews we distributed education material to households with a view of increasing the knowledge and awareness of the species with follow up repeated surveys planned for next year to monitor any change in attitudes as a result of this materials.

Our findings indicated that the most of herders say Pallas's cat is very important species to the environment (N=122: df=121: P=0.37). Moreover, there are no threats on the species (51.5 %) in this region. However some herders did report a range of threats including dog (6.2%), disease(1.5%), lack of prey (3.2%), hunting (2.3%), poisoning (0.8%) and mining (0.8%).. Also our survey shows that local people think rodent plays very important role for Pallas's cat abundance and distribution. Therefore, its distributions increased 57.7% in last 10 years. Furthermore, we need to

develop to raise of Pallas's cat awareness within the herders through more research on its biology and ecology in Mongolia.

Corvids birds in the urban ecosystems of Mongolia and Transbaikalia

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Fourteen species of birds are registered in Mongolia and Transbaikalia, and 9 of them have their nests in urban ecosystems. The quantity of nesting species depends from city's geographical location, surrounding landscapes and their scales. There are two species are nesting (*Pica pica, Pyrrhocorax pyrrhocorax*) in Sainshand (eastern part of the Desert-Steppe landscapes, the population is 25.2 thousand people), 6 species (*Cyanopica cyanus*, *Pica pica, Pyrrhocorax pyrrhocorax, Corvus frugilegus, Corvus orientalis, Corvus corax*) in Ulaanbaatar (the capital city of Mongolia, steppe and forest-steppes landscapes, the population is 1.3 million people), cities Erdenet, Darkhan, Sukhbaatar (the Northern Mongolia, steppe landscapes, the population is 68.3, 65.9, 22.4 thousand people, accordingly) and Kyakhta (the Southern Transbaikalia, steppe and forest-steppe landscapes surrounding, the population is 20.1 thousand people), and there are 4 species (*Pica pica*, *Cyanopica cyanus, Corvus dauuricus, Corvus orientalis*) in Ulan-Ude (forest-steppe and taiga landscapes surrounding).

Pica pica is nesting in all cities of Mongolia and Transbaikalia, *Pyrrhocorax pyrrhocorax* and *Corvus orientalis* are well represented. Among the nesting species of cities, we prevail the species associated with arid ecosystems. There are no taiga species, although they visit cities, which situated in the forest-steppe and taiga zones during winter period. Corvids have a significant role in the birds' population of Central Asian cities. They belong to background and prevailing species, their population has a sharp increase in winter time. The significance of corvids in urban ecosystem is insufficiently studied.

How drought influences on the birds' population in the steppes of the Lake Baikal basin

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An abnormal drought that has spread through a wide area of the Inner Asia for almost 20 years (since 1998) had a significant influence the birds' population in

the steppes. The most steppe birds in the lake Baikal basin sharply depopulated (*Perdix dauurica, Falco naumanni, Falco cherrug, Buteo hemilasius, Aquila nipalensis, Melanocoripha mongolica, Monticola saxatilis, Oenanthe pleschanka, Lanius isabellinus, Emberiza godlewskii* etc.). Such species as *Monticola saxatilis*, *Oenanthe pleschanka* and *Lanius isabellinus* began to occur extremely rarely in the large areas faded away. Some species distributional areas decreased in the northern borders (*Buteo hemilasius, Melanocoripha mongolica, Petronia petronia*), others became more fragmentary in their dispersal areas.

In the same time, long drought has a positive influence on some steppe species. Expanding area and population growth have been noted on lesser short-toed lark (*Alaudala rufescens*) and Asian short-toed lark (*Alaudala cheleensis*). Population of *Anthus godlewskii* and *Oenanthe isabellina* practically did not change. *Anthus godlewskii* noted a higher selectivity to the choice of habitats, in these biotopes, their density of settlements increased. By reason of the drought many steppe biotopes became short grass type and *Oenanthe isabellina* starts gladly populate them.

The basic factor of the negative influence of long term drought is deterioration of the living conditions of steppe animals. Not only bird populations, but also the populations of steppe mammals decreased too. During the drought period, the size of steppe reservoirs decreased, around the salt lakes were formed large areas of saltmarshes, which are willingly settled by some species of larks. These and other factors are the reason of changing of the bird populations in the Lake Baikal region.

Hematological reference values of the Reintroduced eurasian beaver Castor fiber and the effects of age and sex

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Eurasian beavers (*Castor fiber* Linnaeus, 1758) are large, herbivorous, semi-aquatic, territorial, monogamous rodents that live in small family groups and reach sexual maturity around 3 years of age.

Several reintroduction projects were organized, such as release of four individuals in Khovd river in 1960, three families from Voronezh national park to the Yeruu river of Selenge province in 1962, 34 individuals from Bulgan river to Khovd river by scientists of National University of Mongolia and University of Halle, Germany from 1974-1978, and 39 individuals (17 males, 18 females) to the Tes river in 1985-2002.

From the province of Bavaria, Germany and from the province of Kirov, Russia were bought 16 individuals (9 males, 7 females) in 2012 and reintroduced to the Zaan River of the Tuul riverhead. The beavers overwintered at Zaan riverhead and near the Bayanzurkh of the Terelj riverhead. The "Beaver Breeding and Reintroduction Unit" was approved and established in 2012 by the order of Ulaanbaatar city mayor №A/354.

The aim of the study was to obtain some haematological parameters in relation to age and sex values in reintroduced Eurasian beaver populations.

Blood samples taken from the ventral coccygeal blood vessels, 2–4 cm from the base of the tail of 26 individuals were sampled from Beaver Breeding and Reintroduction Unit, Gachuurt Village, Mongolia. Haematological assays were performed using an automatic analyser (BC-2800 Vet). Welsh's two-sample unequal variance t-test was used to compare haematological parameters of male and female Eurasian beavers and to compare age group results of the 95% confidence interval test for mean differences using JMP software version 10.

There were no differences in the haematological values between sexes. Whilst all parameters were found to be similar for male and female beavers, it is interesting to note that there are significantly different haematological results ($p<0.05$) between the age groups for some parameters. We found that age related differences were significant for Gran# ($p<0.0494$), Lymph% ($p<0.0157$), Gran% ($p<0.0100$), HGB ($p<0.0494$), MCH ($p<0.0181$), PLT ($p<0.0029$), and PCT ($p<0.0125$). The correlation between measured haematological parameters was also determined.

Determining barcoding sequence of some Mongolian mammals

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Mongolia has a large land area with highly diverse climate, vegetation, and animal resources. There are at least 128 species of mammals have been registered in Mongolia, most of them are endemic to Central Asia. Sequencing of mitochondrial DNA cytochrome C oxidase subunit I encoding gene region will be an advanced new research for establishing genetic database for determination of biological species and diversity. For this purpose 215 blood and tissue samples of Mongolian mammals have been collected and subjected to initial processing. Genomic DNA was extracted and purified from processed samples and added to DNA collection at Molecular biology laboratory, Department of Biology, NUM

Barcoding sequence of mitochondrial cytochrome oxidase I gene was amplified and sequenced from 137 tissue samples representing more than 80 mammalian species. We determined genetic barcoding sequence of 94 samples using relevant software

and successfully registered sequences in National Center for Biotechnology Information (NCBI) database and obtained GenBank accession numbers. This is the first case when genetic barcoding sequences of Mongolian mammals have been registered in NCBI database. As a result of this project we have established database for the identification of mammalian species using DNA barcoding sequences obtained from 94 specimens representing 53 species belonging to 7 orders, 20 families.

Pilot survey on population estimate of the Wild Bactrian Camel, *Camelus ferus* in Mongolia

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The wild Bactrian camel (*Camelus ferus*) was listed as regionally Endangered (C1) and globally Critically Endangered (A3de, A4ade) in Mongolia. The global distribution of the wild Bactrian camel is restricted to three distinct populations in Mongolia and China; in Mongolia the species is confined to the Great Gobi "A" Strictly Protected Area in the south-west of the country on the border with China. Recent studies have indicated the total global population size is small and probably declining. The population decline of the species is one of the reasons of conducting field survey on population estimates. An aerial survey in 1997 sighted 277 individuals and estimated the population at between 1985 and 802 individuals (Mix et al., 002). A ground-based line transect survey in 2004-05 over a portion of the distribution estimated a total population of 463±92 adults (Dovchindorj et al., 2007) within a total area of 29,000±2000 square kilometres. This study aim was to provide a robust estimate of the size of the *C. ferus* population in Mongolia a decade after the last population study was published Reading *et al.* (1999) in Mongolia. During October 2014 we conducted a population survey of Mongolia's Wild Bactrian Camel in the Great Gobi 'A' Strictly Protected Area, Southern Mongolia. This site covers the only Bactrian camel range in Mongolia and one of only three remaining wild populations globally. Using ground-based distance sampling, we estimated a population of 623 wild camels (95% CI=302-1288 CV=37.8%) in Mongolia. This is one of the lowest estimates recorded using robust distance sampling techniques since 1999. We suggest that model selection criteria and specific analysis settings should be reported in future distance-based surveys of the wild Bactrian camel to ensure comparability of approaches and hence reliability of trend estimates.

Water quality of upstream of Tuul River, where the beavers introduced

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Scientists believe beavers can contribute to river ecosystem regeneration and restoration because their natural dams help maintain river levels during the dry season, while the flooded areas help nourish the soil and plant growth. "Beaver introduction project" team was sampled 3 sites in the upstream of Tuul river, during the summer season of 2013-2016. Species diversity and community composition were determined using generic level aquatic macroinvertebrate data. Analysis of variance was used to determine whether insect metrics and water quality variables varied significantly among sites. Ephemeroptera and Diptera richness increased with low conductivity and pH, Plecoptera and Trichoptera richness positively correlated with DO, water temperature and turbidity, but not significantly. Abundances of Ephemeroptera and Trichoptera varied significantly between sites. Cluster analysis determined the upper parts of the Tuul river were more similar than the lower site (Terelj) in terms of community composition. Biotic indices determined the water quality of the upper parts of Tuul river (Zaan and Terelj streams), where the beavers were introduced in 2011, was excellent. More investigation would help access the changes in the assemblage and consequently the conservation of their habitats.

Phenotypical characterization of eight thermophilic bacterial strains from hot springs in Mongolia

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Eight strains of thermophilic bacterial were isolated from two different hot springs in Mongolia, Shargaljuut. Cell are Gram positive-stain, strictly aerobic, grew optimally at pH 8.0-9.2 and temperature of 55 to 60^0C , and tolerated maximally 10% (w/v)NaCI. The eight isolates were cellulose, amylase and protease producers with variable degrees of enzymatic activity.
All strains were phenotypically characterized (microbiological, biochemical and biotechnological): optimal temperature, effect of sodium chloride and pH during

growth, type of fermentation, auxogram, production of polysaccharides, ability to hydrolyze the starch, arginine and esculine hydrolysis, resistance to billiary salts, production of H_2S, reduction of the tetrazolium salts,production of oxygenated water, production of catalase, Voges Proskauer reaction, etc. All strains were identified with API 50CHB/E microtest systems from BioMerieux SA. Phylogenetic analysis of 16S rRNA sequence for the 8 strains reveal that these strains have high sequence similarity with *Bacillus* sp., *Brevibacillus borstelensis*, *Brevibacillus thermoruber and Bacillus Licheniformis,* respectivery.

Population structure of *Sorex caecutiens* in a montane taiga forest of West Khentey, Mongolia

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Shrew‘s survey was held in the area of ecological research station Khonin-Nuga (the upper reaches of the river Yeroo in West Khentey Mountains) over a period of 12 years, from 2000 to 2011. Pitfall trapping and mark-recapture live trapping was used. Seven species were recorded; among *Sorex caecutiens* was the most abundant and recorded in all major habitats. The population shows strong oscillations during the 12 year period. The capture rates of *S. caecutiens* was the highest at the floodplain meadows and dark and light coniferous forest plots. The sex ratio is unbalanced; there are more females in the general (1.12:1) especially in the adult population (1:1.33).

Predictive mapping of plant communities in Bulgan river basin

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The Bulgan river basin is a central part of the ecosystems and thus also livelihoods in the Dzungarian Gobi. Our research has two main goals:

- Describe plant communities in their environmental context, map the vegetation.
- Understand effects of abiotic and biotic drivers including grazing on vegetation patterns.

In 2012 & 2013, we sampled 251 plots along the Bulgan river using a modified Braun-Blanquet approach: Relevés were 10 m x 10 m in size; vascular plant cover was estimated in percentages. Sites were deliberately chosen to represent relevant vegetation types from mountains to oases and mapped using Landsat imagery obtained from the Global Land-cover facility (http://glcf.umiacs.umd.edu): southern and northern Landsat scene (path 141, rows 27 and 28, from date 08.08.2012). Altitude, slope and aspect served as predictors, processed based on SRTM (http://srtm.csi.cgiar.org) with spatial resolution of 90 m x 90 m.

We found four different main vegetation types encompassing sixteen communities, the main types are: mountain, mountain steppe, desert and oases.

The vegetation map clearly demonstrate the overwhelming importance of altitudinal gradients in the study region. The floodplains host riverine meadow. The surrounding lowlands host broadly similar desert steppes and various desert communities in all watersheds, which are replaced by mountain steppes at higher elevations.

Plant comunities of the Dzungarian Gobi

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We surveyed vegetation in the Dzungarian Gobi, which differs from other Mongolian dryland regions by its flora hosting many species from Middle and even western Eurasian regions. The data collection stretched over 3 different periods: In 2003, we sampled 208 plots, in 2010 156 plots, and during the vegetation period of 2012-2014 284 plots using a modified Braun-Blanquet approach. Sample sites were deliberately chosen to represent relevant vegetation types, ranging from higher mountains to the oases. In addition, biomass, soil samples and environmental data were collected as well. Based on our result we found four different main vegetation types encompassing twenty-one communities in total. Main vegetation types are

mountain, steppe, desert and oases, which showed a clear altitudinal distribution except for oases. In addition, DCA analysis revealed a close correlation between altitude and species composition and productivity.

Responses of some ecohydrological variables and aboveground net primary production (ANPP) of boreal steppe of Northern Mongolia to plant litter and rainfall manipulation

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Significant effects of litter presence on functioning of grassland ecosystems have been reported, but how variations in litter mass correspond to ecohydrological processes and ANPP variability is still uncertain. We tested the questions in the boreal steppe of Mongolia: How do variations in litter mass explain soil moisture variability via influx and efflux processes of water? How does litter amount relate to ANPP? In 2011 and 2012 years, we carried out a field experiment manipulated litter mass from zero to 100% of the mean litter mass of the ecosystem (64 $g.m^{-2}$), and rainfall event sizes. SOILWAT was used to model the ecohydrological processes of the experimental plots. Litter significantly affected soil moisture in a dry year, while this effect was not detected in a wet year. The mean naturally occurring litter mass did not significantly affect the influx (infiltration) of water via interception. Efflux via soil evaporation from bare and litter-covered soils differed between years, but not between litter levels. Litter levels did affect ANPP and only graminoids biomass. The significant effect of litter on ecohydrological responses to litter mass in dry years could signify its importance for future climate with more variable precipitation.

Diversispora spurcum enhanced drought resistance of Mongolian crested wheatgrass (*Agropyron cristatum* L.)

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In the present study, drought resistance of crested wheatgrass (*Agropyron cristatum* L.) as influenced by arbuscular mycorrhizal fungi (AMF), *Diversispora spurcum,* was evaluated. The effects of *D. spurcum* on characteristics of the growth, nutrient uptake, gas exchange, chlorophyll and proline content of crested wheatgrass were

studied in pot culture under drought stress. The applied drought stress reduced growth vigor of mycorrhizal and non-mycorrhizal plants as compared to non-stressed plants.
Under drought stress, mycorrhizal plants had higher nutrient uptake, chlorophyll content and gas exchange capacity, compared with non-mycorrhizal plants. Furthermore, the proline content of inoculated plants was significantly higher than non-inoculated ones under drought stress. Inoculated plants took more days to show signs of drought stress (leaf folding, loss of shoot and wilting of leaves). Consequently, arbuscular mycorrhiza formation highly enhanced the drought resistance of crested wheatgrass, which increased nutrition acquisition and proline content.

Arsenic toxicity effects on different groups of algae in laboratory cultivated biofilms

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The toxicity of chemicals in the environment is influenced by many factors, such as the adsorption to mineral particles, active biological surfaces, biotransformation and/or nutrient concentration. In the present study, a simplified fluvial system including fish, periphyton and sediment was used to investigate the fate and effects of a long-term, environmentally realistic concentration of arsenic (As) exposure on biofilm growth, different groups of algae and nutrient cycling. Total dissolved arsenic concentration decreased exponentially from 120µg/L to 28.0±1.5 µg/L after 60 days, mostly sinking to the sediment and a smaller percentage accumulated in the periphytic biofilm. Photosynthetic efficiency, photosynthetic capacity and minimum fluorescence yield were measured with the PhytoPAM (Pulse Amplitude Modulated) fluorimeter). The PHYTO-PAM employs light-emitting-diodes (LED) to excite chlorophyll fluorescence light pulses at four different wavelengths (470, 535, 620 and 650 nm), which can be used respectively to gain information on the relative abundance of differently pigmented organisms, such as, for example, green algae (green), diatoms (brown) and cyanobacteria (blue). The groups of algae had different response to this chronic toxicity influence. As well as, most P and N, which was provided by fish, was retained in the epipsammic biofilm (growing on sediment grains). We conclude that exposure to this concentration of arsenic under oligotrophic conditions is changing the quality and quantity of the base of the aquatic food chain and its respective contribution to nutrient cycling, impairing the normal functioning of the ecosystem: lowering the total biomass of biofilm and its potential

ability to use organic P (i.e. phosphatase activity), inhibiting algal growth, especially diatoms, decreasing nitrogen contents and making the epipsammic biofilm more heterotrophic, thus reducing its ability to oxygenate the aquatic environment.

Eurasian cranes sightings in Western and Southern Mongolia

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Asia is the largest center of crane species diversity, where nine of 15 world cranes species inhabit. In Mongolia there are six crane spesies: White-naped, Eurasian and Demoiselle cranes breed and Siberian Hooded and Red-crowned cranes are seen in summer or during migration. In Western Mongolia four crane species are recorded: Eurasian, Demoiselle, Hooded, and White-naped cranes.
Eurasian Crane observations carried out in 2013 in Western Mongolia and in 2014 in Southern Mongolia. On 21 September 2013 a pair of the Eurasian Crane was sighted in the west of Mongolia (Dzavhansky Aimak, Oigon Lake, 18 km north Tudevtei Somon). On 30 September 2014, a flock of 22 migrating cranes were seen in the south of Mongolia (South-Gobi Aimak, Tsetsi-Ula Mountain, 45 km southeast Tsogttsetsi Somon).

Floodplain plant community response to the climate change

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Floodplains are species-rich when compared to surrounding ecosystems and valuable pasture and hey resource for nomadic herders and stated as the most overgrazed pasture type in Mongolia. Since the flow regime determines the successional evolution of floodplain plant communities it is important to monitor them in relation to the flow dynamics. Monthly runoff of high (1978-1995) flow years of Orkhon River and its confluence South Tamir River decreased two and three times compare with low (1996-2008) flow years.
Plant community analysis conducted at 7 sites along the Orkhon and South Tamir River floodplains in the summer of 2016 using Braun-Blanquet technique in order to compare with the plant community structure defined in early 1970s. Community structure changed drastically and occurrence and cover of the hydrophytes and

mesophytic species decreased while the xerophytes increased. Average NDVI, calculated basing on the satellite images taken in 17-19th of August of 1991, 1997, 2003, 2009, 2015, continuously decreased from 0.51 to 0.27. While high biomass area decreased twice, the low biomass area increases 17 times. More detailed results will be presented.